

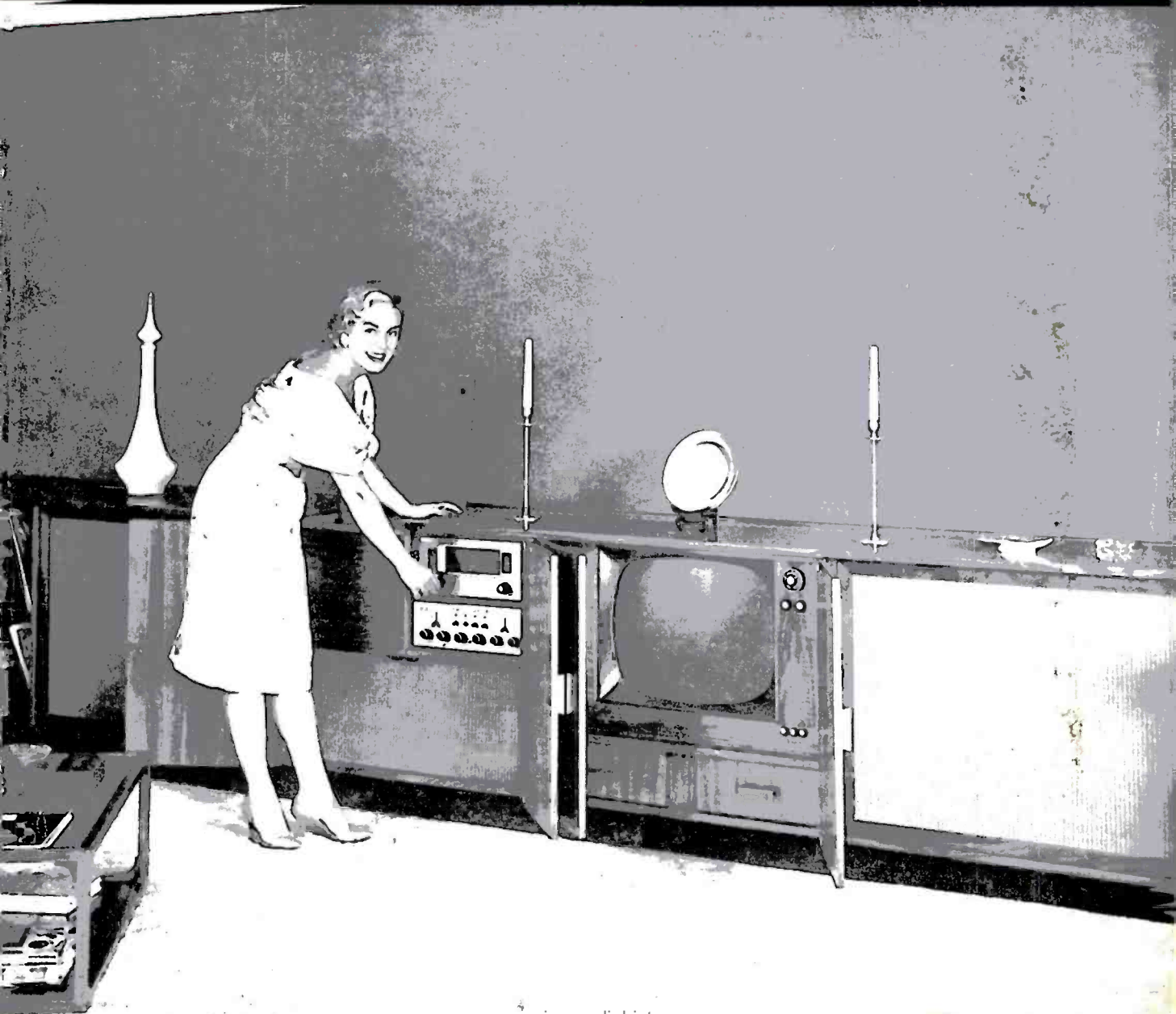
# AUDIO

PRODUCT PREVIEW

AUGUST, 1959  
50¢

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**COVER PHOTO:** Custom installation in North Stamford, Connecticut, designed by C. F. Barton, with cabinetry by Russ Lang Corp., Bridgeport Conn. Unit is 14 feet long in three sections; the record cabinet is two feet long and features an interior light. For further data and a close-up picture of control panel, record changer compartment, and ventilating ducts, turn to page 104. Photos by Frederick Schulze.

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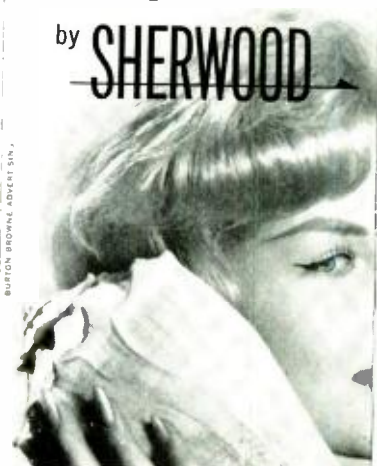


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# AUDIOCLINIC??

JOSEPH GIOVANELLI\*

## Power and Voltage Considerations

*Q. The specifications of my Dynakit amplifier indicate that 1.6 volts input are required for 60 watts output. It therefore seems like an easy matter to measure the voltage at the output terminals when the amplifier was fed by a 1.6-volt signal. This voltage was found to be approximately 40 volts. Since my speaker cannot handle 60 watts, this was a no-load measurement. I could not experiment with a lower input because I did not know the corresponding output wattage. It would seem that the Ohm's law a.c. formulas should be applicable to this problem. Please tell me a simple way to determine wattage from voltage. What is the relation between input voltage and watts output? Tell me how to determine the phase angle, for I understand that this may have some bearing upon the problem. Richard Meyer, East Lansing, Mich.*

A. Power is a measure of the work being done. Now, when you measured the amplifier's voltage output under no-load conditions, you arrived at a situation wherein you had voltage developed, but that voltage was doing no work of any kind because it was fed into nothing. In order to determine anything about the wattage of your amplifier, the signal must be fed into something which would be indicative of the conditions under which the amplifier normally works. As you said, your speaker system cannot take all the power which can be provided by the Dynakit, and in fact, neither could your ears. What is needed, then, is a device which will act as much like a speaker as possible, but will make no sound. What is done in practice is to take a resistor equal to the impedance of the amplifier tap selected for the experiment. This resistor should be of as high a wattage rating as possible since your amplifier delivers 60 watts. Don't be alarmed if you do not have one that can handle that much power; a 10-watt resistor can handle as much as 80 watts for a short while, probably long enough for you to compute your data. Under these conditions the transformer is loaded, thereby reducing the back voltage it produces. This, in turn, indicates that the voltage at the output of the secondary will be less than the unloaded value; measurement will bear this out.

When the impedance between a speaker and its driving amplifier is matched, the system is said to be resistive, and for this reason, the phase angle need not be considered. Actually, the phase angle may enter into the picture somewhat since the match is not perfect, and the speaker behaves like an inductance or capacitance at different parts of the spectrum.

In explaining just what is meant by the phase angle a brief discussion of alternating current is needed. When a.c. flows through a resistance, the voltage and current are in phase, which means that as the voltage rises to a maximum in one direction, the current rises to a maximum in

that same direction, and the two arrive at that maximum at the same instant. When this same current is applied across the terminals of an inductance, the situation is quite different. This can be made clear by considering what happens when d.c. is applied to the inductance. When the voltage is applied, there is a magnetic field set up around the inductance. This field cuts the turns of the inductance, causing a second voltage to be generated within the coil. By the rules of magnetic theory we know that when this happens, the direction of this newly created back voltage is opposite to that of the originally applied voltage. This tends to oppose the flow of current. Soon the magnetic field reaches a maximum intensity because we are feeding d.c. to the coil, and this will ultimately cause the current to stabilize. From that time on, the inductance behaves as though it were resistive. When the inductance is fed from a.c., however, the voltage and current can never catch up with each other, for, as the current tries to do so, the cycle reverses and the whole thing starts all over again. We say that, for an inductance, the voltage leads the current by 90 deg. "How," you wonder "did the degrees enter into this?" A.c. is cyclical in character. A cycle starts off at zero, rises to a maximum in one direction, falls back to zero, and rises to a maximum of opposite polarity exactly equal in magnitude to that of the first rise, and then it returns to zero again. It next starts all over again, rising to a maximum in the first direction. (This is based upon the assumption that the wave described is a pure sine wave.) The whole thing goes round and round. A circle could, therefore, be drawn to represent this action. If it is considered that this cycle is traveling in a counterclockwise direction, the voltage will, when a pure inductance is the only element involved, be 90 deg. to the left. Unfortunately, we never get a pure inductance: there is always some resistance present. This reduces the leading or lagging effect, or, in other words, the phase angle. Just how much this is reduced will depend upon the amount of inductance and upon the amount of resistance present. The whole thing can be considered as a right triangle whose hypotenuse represents the combined effects of inductance and resistance. Naturally, all mathematical work will proceed vectorially since the hypotenuse represents the square root of the sum of the squares of the other two sides of the triangle. This concept is basic to Plane Geometry and Trigonometry, and hence will not be explained further here.

Capacitors behave in a manner opposite to that of inductances. The current in a capacitor leads the voltage by 90 deg. Capacitors contain resistance also and there is no such thing as a pure capacitance.

The reasons for the behavior of a capacitor are best explained by considering what happens when the capacitor is connected to d.c. Since the plates are neutral, the electrons rush to crowd on to one plate at the moment the circuit is closed. This action is so great at the first instant that

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Lastly, you wished to know about the relationship of the variations in output voltage of an amplifier to the power delivered to the load. If the input of an amplifier requires two volts for a power output of 20 watts, the power output will be reduced to 5 watts if the input voltage is reduced to 1 volt. That is, the power varies as the square of the voltage. However, the input and output voltages will vary directly. If I reduce the signal voltage to  $\frac{1}{2}$ , the output voltage will fall to  $\frac{1}{2}$  of what it had been before the reduction in input voltage had been made.

The next logical question is: "Why does the power vary as the square of the voltage?" Power is equal to voltage times current,  $E \times I$ . It does not matter that the current is not known since we do know the resistance into which the power is being fed. We know that the current is equal to the voltage divided by the resistance,  $E/R$ . Thus wattage,  $W$ , equals  $E \times E/R$ , or  $E^2/R$ . That is how the exponential business creeps in to destroy what would have been a simple arithmetic problem.

Assume an amplifier to which is connected a 16-ohm resistor between the 16-ohm tap and common. Assume a signal of one volt is applied to the input grid. Assume that the voltage read across the 16-ohm resistor under these signal conditions is 20 volts. What power is the amplifier supplying to the resistor?


Solution: in our derived formula,  $W = E^2/R$ , we can substitute our two knowns as follows:  $E = 20$  volts,  $R = 16$  ohms. Therefore, the formulas can be rewritten to read  $W = 20^2/16$ , or  $400/16$ , which is 25 watts.

If the input voltage is reduced to 0.5 volt, the voltage as read across the 16-ohm resistor will be 10 volts. By applying our formula, we see that the power supplied to the resistor under these conditions is 6.25 watts, rather than the 12.5 watts we might have expected.

The following information does not bear directly upon the foregoing problem, but it is similar in some respects. Suppose it is necessary to determine the power being supplied to a resistance when only the values of the current and of the resistance are known. Voltage can be readily obtained by multiplying current by resistance,  $I \times R$ . The result can be multiplied by the current and the resulting answer will be the desired power. These operations, however, can be combined as follows: The voltage is equal to the current times the resistance,  $E = IR$ . The fundamental formula for power is voltage times current, or  $EI$ . Since  $E$  is equal to  $IR$ , power is equal to  $I \times IR$ , or  $I^2R$ .  $E$

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# LETTERS

## Stereo Recording in Education

SIR:

For several years I have been studying, including school committee work, some of the possibilities for more effective use of teacher competencies in our schools and adult education. One of these involves the use of stereo tape recording for improving music programs and in the language teaching laboratory in elementary and high schools. The latter art is fairly well developed and accepted at College levels, but not in the lower levels. Perhaps some of your readers may have developed some information that would be helpful.

Most of the experiments (including two by one district by calling in professional recorders) on the use of two-channel recorders in music programs have been considered by the school people as rather complete failures (in spite of their recognition of the commercial acceptance of stereo reproducers in consumer products area, though some think it is a fad).

Admitting that stereo-binaural pick-up and recording is difficult does not justify our continued neglect to provide some sort of guides, suggestions, cautions, and more specific considerations of the art. I have written several recorder manufacturers about this problem, and I have contacted owners of this equipment. The story generally is that the equipment is not good enough for the job, and I think there will be a reaction against stereo recorder units if this situation is not changed so that these owners can get better results. I feel that the trouble is not with recorders, but with the pick-up and recording techniques. It seems that the manufacturers have not provided good application instructions for the most effective stereo pick-up and recording results, with some discussions of some of the "tricks" of the trade on how to make the final results more desirable and how to better adapt the system to the particular musical demonstrations. The user needs to know how to plan for different applications of strings, bands, large and small groups, music rooms, solo, choral, and other types of work. All of this is a part of the over-all use of and satisfaction from this kind of equipment by the more discriminating users and for educational applications.

Perhaps this sort of thing has been done. If so, I have not found it. I know of several others in school work and citizen applications who have also looked for this kind of information; some have relegated the equipment to storage and relatively inconsequential use, somewhat discouraged that they spent the money in the first place, (not talking about disc equipment). If this kind of information is available, perhaps you can inform me, with references. If not, perhaps you could get some articles in your magazine on the more effective use of stereo tape recorders.

As a school board member I feel that we could improve our musical programs by using stereo recorders. In addition I think that such tapes could be used in demonstrations to further our already meagre public relations programs. Such proposals generally meet with the problems of poor

results, high costs, lack of time to experiment, and so on. If we had more information available as a sort of criteria for such applications perhaps satisfying results could be obtained; at least people would be better apprised of the requirements and correct procedures.

The school publication in the audio visual fields do not seem to do anything about this situation. Perhaps it takes an appreciably higher technical level of writing and experience to get the idea over and to be specific in enough areas, or to take such a big subject and bring it into the language of this type of prospective user of stereo recording equipment. In my search I reached an audio engineer in Hollywood who had developed such instructions and would provide an article or manual for \$50—too much for people in school activities.

At any rate here is the problem. Perhaps some of your readers will be able to help or to provide some references.

LLOYD P. MORRIS,  
2947 N. 78th Court,  
Elmwood Park,  
Chicago 35, Ill.

*(And a serious problem it is, too. Unfortunately, most stereo recording techniques are regarded as at least "confidential" if not "top secret," and it is rare that we are permitted to reproduce a photo of an actual recording session with the microphones all in place. However, we do not consider \$50 too high if the manual were written to your order—in fact, it is so low that it probably wouldn't be worth even that amount. We have never encountered anyone with professional experience who was willing to give out any information. It would be desirable for all the tape and recorder manufacturers collectively to commission someone to write such a book—and we hope they do, we'd like to publish it. Here's hoping some reader in your vicinity may volunteer to help you out, and possibly to annotate his findings for later publication for everyone interested. Ed.)*

## More Desirable Subjects

SIR:

May I suggest a couple of topics that I have not seen covered anywhere in more than incidental fashion that should be useful to many readers?

How about a really thorough article by a competent authority on the use of voltage regulator tubes, including possible uses and applications, precautions and things to avoid, and possible troubles and what to do about them. The same suggestions go for the design and use of regulated power supplies employing vacuum tubes with control grids. Design of such circuits should not be beyond the capabilities of the average technician or advanced amateur.

I would like to know of any books that contain this information. The best I have been able to find on VR tubes so far has been from the Heathkit catalogues before they started omitting values from the schematics.

KEITH CONRAD,  
816 W. Belle Plaine Ave.,  
Chicago 13, Ill.





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# ANOTHER FIRST FOR HEATHKIT®

## ... amplifier power rating standards

Heathkit is accustomed to pioneering . . . to leading the way. We led the way into the kit field of electronic equipment. Now, we are leading the way to audio amplifier power rating standards . . . standards clearly defined to assure you of Heathkit quality . . . to enable you to compare before you buy.

The Heathkit amplifier standards have been established upon the following beliefs after reviewing over one hundred published treatises on the subject:

WE BELIEVE any amplifier should be rated for its intended use . . .

**PROFESSIONAL** amplifiers must be so nearly perfect that no audible change occurs in the program material.

**HIGH FIDELITY** amplifiers must be almost as perfect, almost as efficient.

**UTILITY** amplifiers can be less perfect and still fulfill their practical job.

WE BELIEVE the rated power of an amplifier in any of the above "use" categories should be that power which satisfies all requirements in that category.

Each of the three "use" categories we have chosen has requirements which can be translated into performance specifications with rather definite limits . . . limits established by recognized authorities. The Heath requirements and their limits for each of the categories are as follows:

### PROFESSIONAL RATING

The professional power rating shall be that power which satisfies the following five tests:

1. Maximum power at which total harmonic distortion (THD) does not exceed 0.3% at 1000 CPS.
2. Maximum power at which total harmonic distortion (THD) does not exceed 2.0% at 20 CPS.
3. Maximum power at which total harmonic distortion (THD) does not exceed 2.0% at 20,000 CPS.
4. Maximum power at which response does not deviate by more than  $\pm 1$  db between 20 and 20,000 CPS.
5. Maximum equivalent single-frequency power at which intermodulation distortion does not exceed 1.0% (60 and 6000 CPS, 4:1).

### HIGH FIDELITY RATING

The high fidelity power rating shall be that power which satisfies the following five tests:

1. Maximum power at which total harmonic distortion (THD) does not exceed 0.7% at 1000 CPS.
2. Maximum power at which total harmonic distortion (THD) does not exceed 2.0% at 30 CPS.
3. Maximum power at which total harmonic distortion (THD) does not exceed 2.0% at 15,000 CPS.
4. Maximum power at which response does not deviate by more than  $\pm 1$  db between 30 and 15,000 CPS.
5. Maximum equivalent single-frequency power at which intermodulation distortion does not exceed 2.0% (60 and 6000 CPS, 4:1).

### UTILITY RATING

The utility power rating shall be that power which satisfies the following five tests:



1. Maximum power at which total harmonic distortion (THD) does not exceed 1.0% at 1000 CPS.
2. Maximum power at which total harmonic distortion (THD) does not exceed 3.0% at 60 CPS.
3. Maximum power at which total harmonic distortion (THD) does not exceed 3.0% at 7000 CPS.
4. Maximum power at which response does not deviate by more than  $\pm 1$  db between 60 and 7000 CPS.
5. Maximum equivalent single-frequency power at which intermodulation distortion does not exceed 3.0% (60 and 6000 CPS, 4:1).

We at the Heath Company are now rating all our amplifiers to these standards. To show you just how this rating system works, let's look at the Heathkit EA-3 amplifier:

As a professional amplifier—

1. Maximum Power at which T.H.D. does not exceed 0.3% at 1000 CPS: 15.1 watts
2. Maximum Power at which T.H.D. does not exceed 2.0% at 20 CPS: 13.9 watts
3. Maximum Power at which T.H.D. does not exceed 2.0% at 20,000 CPS: 15.3 watts
4. Maximum power at which response does not deviate more than  $\pm 1$  db between 20 and 20,000 CPS: 17.6 watts.
5. Maximum equivalent single-frequency power at which intermodulation distortion (60 and 6000 CPS, 4:1) does not exceed 1%: 18.0 watts.

Taking that power which satisfies all five tests, we could rate the EA-3 for professional use, at 13.9 watts. Its advertised professional rating is a conservative 12 watts.

A review of the chart below shows why the EA-3 is rated at 14 watts for high fidelity applications, and 16 watts as a utility amplifier.

Notice that our specifications are set at rated power for one or more classifications (when our customers need an amplifier for a particular use, we believe they want it to deliver its rated power under those particular conditions). Observe that our distortion figures are specified at the limits of the amplifier frequency range as well as at the traditional 1000 CPS (the common practice of rating distortion only at 1000 CPS does not tell you what happens throughout the full range of the amplifier).

As an example of how these standards work on several competitive amplifiers, we have prepared the following chart. Notice that if the amplifiers did not meet standards at rated output power, we have determined the power output where they do meet the standards set up under the three categories.

AMPLIFIER COMPARISON CHART

Amplifier Description and Price	Heath Standard Rating		Maximum Power Output Satisfying:				
	Classification	Power (watts)	Power Rating at Test 1 Stds.	Power Rating at Test 2 Stds.	Power Rating at Test 3 Stds.	Power Rating at Test 4 Stds.	Power Rating at Test 5 Stds.
Kit "A" "12 w. HI FI" \$23.90	Professional High Fidelity Utility	Disqualified Disqualified 8.6 watts	8.4 watts 9.1 9.8	0.02 watts 1.3 8.9	0.65 watts 1.67 8.6	Disqualified Disqualified 12.3 watts	3.9 watts 5.9 11.6
Assembled Amp. "B" "14 w. HI FI" \$39.50	Professional High Fidelity Utility	0.3 1.1 7.8	4.7 12.1 13.2	0.3 1.1 7.8	4.8 5.7 12.9	1.2 6.3 15.8	4.0 8.2 13.9
Kit "C" "12 w. HI FI" \$34.95	Professional High Fidelity Utility	3.6 8.0 11.9	11.0 11.8 12.0	3.6 8.0 12.0	7.5 11.2 11.9	7.5 13.4 15.0	6.5 14.3 14.9
Assembled Amp. "D" "15 w. HI FI" \$64.50	Professional High Fidelity Utility	3.8 10.6 14.7	13.2 14.3 14.7	3.8 10.6 14.7	14.5 14.5 15.0	12.0 18.3 23.7	14.6 16.3 17.0
Heathkit EA-3 "14 w. HI FI" \$29.95	Professional High Fidelity Utility	13.9 15.5 16.4	15.1 16.2 16.5	13.9 15.8 16.6	15.3 15.5 16.4	17.6 18.3 19.0	18.0 18.9 19.5

The Heathkit amplifier power rating standards have been established as further assurance to you of the high quality of our products. We will live by these standards until industry-wide standards are established.



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### MONAURAL-STEREO PREAMPLIFIER KIT (Two Channel Mixer)

MODEL SP-2 (stereo) \$56.95 Shpg. Wt. 15 lbs.  
 MODEL SP-1 (monaural) \$37.95 Shpg. Wt. 13 lbs.  
 MODEL C-SP-1 (converts SP-1 to SP-2) \$21.95 Shpg. Wt. 5 lbs.

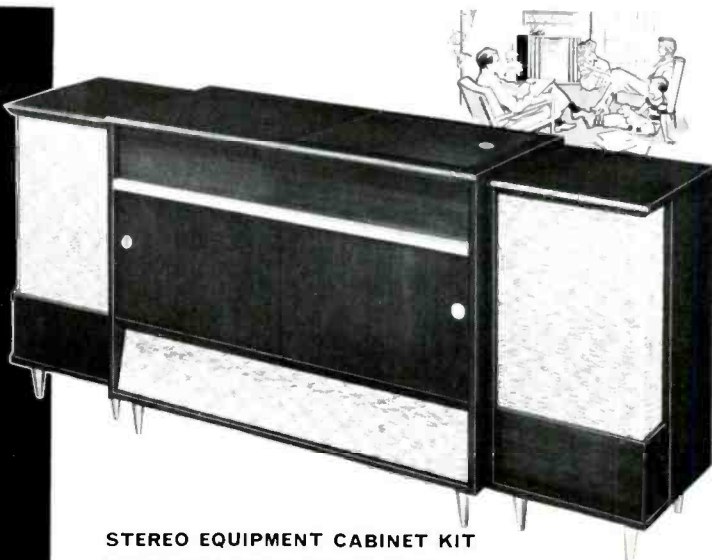
Special "building block" design allows you to purchase instrument in monaural version and add stereo or second channel later if desired. The SP-1 monaural preamplifier features six separate inputs with 4 input level controls. A function selector switch on the SP-2 provides two channel mixing. A 20' remote balance control is provided.



### PROFESSIONAL STEREO-MONAURAL AM-FM TUNER KIT

MODEL PT-1 \$89.95

The 10-tube FM circuit features AFC (automatic frequency control) as well as AGC. An accurate tuning meter operates on both AM and FM while a 3-position switch selects meter functions without disturbing stereo or monaural listening. Individual flywheel tuning on both AM and FM. FM sensitivity is three microvolts for 30 db of quieting. The 3-tube FM front end is prewired and pre-aligned, and the entire AM circuit is on one printed circuit board for ease of construction. Shpg. Wt. 20 lbs.



### STEREO EQUIPMENT CABINET KIT

MODEL SE-1 (center unit) \$149.95

Shpg. Wt. 162 lbs.

MODEL SC-1 (speaker enclosure) \$39.95 each


Shpg. Wt. 42 lbs.

Superbly designed cabinetry to house your complete stereo system. Delivered with pre-cut panels to fit Heathkit AM-FM tuner (PT-1), stereo preamplifier (SP-1 & 2) and record changer (RP-3). Blank panels also supplied to cut out for any other equipment you may now own. Adequate space also provided for tape deck, speakers, record storage and amplifiers. Speaker wings will hold Heathkit SS-2 or other speaker units of similar size. Available in unfinished birch or mahogany plywood.

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### HIGH FIDELITY RECORD CHANGER KIT

MODEL RP-3 \$64.95

Turntable quality with fully automatic features! A unique "turntable pause" allows record to fall gently into place while turntable is stopped. The tone arm engages the motionless record, and a friction clutch assures smooth start. Automatic speed selector plays mixed 33 $\frac{1}{3}$  and 45 RPM records regardless of sequence. Four speeds available: 16, 33 $\frac{1}{3}$ , 45 and 78 RPM. Changer complete with GE-VR-11 cartridge with diamond LP and sapphire 78 stylus, changer base, stylus pressure gauge and 45 RPM spindle. Shpg. Wt. 19 lbs.

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A real work horse packed with top quality features, this hi-fi amplifier represents a remarkable value at less than a dollar per watt. Full audio output at maximum damping is a true 55 watts from 20 CPS to 20 kc with less than 2% total harmonic distortion throughout the entire range. Featuring famous "bas-bal" circuit, push-pull EL34 tubes and new modern styling. Shpg. Wt. 28 lbs.



MODEL W7-M \$54.95



**NEW**



**NOTE THESE OUTSTANDING SPECIFICATIONS:** Power Output: 14 watts, Hi-Fi; 12 watts, Professional; 16 watts, Utility. Power Response:  $\pm 1$  db from 20 cps to 20 kc at 14 watts output. Total Harmonic Distortion: less than 2% 30 cps to 15 kc at 14 watts output. Modulation Distortion: less than 1% at 16 watts output using 60 cps and 6 kc signal mixed 4:1. Hum and Noise: mag. phono input, 47 db below 14 watts; tuner and crystal phono, 63 db below 14 watts.

**14-WATT HI-FI ECONOMY AMPLIFIER KIT**  
**MODEL EA-3 \$29<sup>95</sup>**

From HEATHKIT audio labs comes an exciting new kit . . . New Styling, New Features, Brilliant Performance! Designed to function as the "heart" of your hi-fi system, the EA-3 combines the pre-amplifier and amplifier into one compact package. Providing a full 14 watts of high fidelity power, more than adequate for operating the average system, the EA-3 provides all the controls necessary for precise blending of musical reproduction to your individual taste. Clearly marked controls give you finger-tip command of bass and treble "boost" and "cut" action, switch selection of three separate inputs, "on-off" and volume control. A hum balance control is also provided. The convenient neon pilot light on the front panel shows when instrument is on. Styled to blend harmoniously into any room surroundings, the handsome cover is of black vinyl coated steel with gold design and features the new "eyebrow" effect over the front panel to match the other new Heathkit hi-fi instruments. The panel is satin black with brush-gold trim strip, while the control knobs are black with gold inserts. Shpg. Wt. 15 lbs.

**"MASTER CONTROL" REAMPLIFIER KIT**

**MODEL WA-P2 \$19<sup>75</sup> (Not illustrated):**

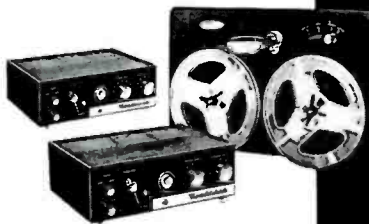
All the controls you need to master a complete high fidelity system are incorporated in this versatile instrument. Features 5 switch-selected inputs each with level control. Provides tape recorder and cathode-follower outputs. Full frequency response is obtained within  $\pm 1\frac{1}{2}$  db from 15 to 35,000 CPS and will do full justice to the finest available program sources. Equalization is provided for LP, RIAA, AES, and early 78 records. Shpg. Wt. 7 lbs.

**MODEL TR-1A:** Monophonic half-track record/playback with fast forward and rewind functions. Shpg. Wt. 24 lbs. **\$99<sup>95</sup>**

**MODEL TR-1AH:** Half-track monophonic and stereo record/playback with fast forward and rewind functions. Shpg. Wt. 35 lbs. **\$149<sup>95</sup>**

**MODEL TR-1AQ:** Quarter-track monophonic and stereo with record/playback fast forward and rewind functions. Shpg. Wt. 35 lbs. **\$149<sup>95</sup>**

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**NOW! TWO NEW STEREO-MONO TAPE RECORDERS IN THE TR-1A SERIES**

Offering complete versatility, the model TR-1A series tape recorders enable you to plan your hi-fi system to include the functions you want. Buy the new half-track (TR-1AH) or quarter-track (TR-1AQ) versions which record and playback stereo and monophonic programming, or the half-track monophonic record-playback version (TR-1A).

Precision parts hold flutter and wow to less than 0.35%. Four-pole, fan cooled motor. One control lever selects all tape handling functions. Each tape preamplifier features NARTB playback equalization, separate record and playback gain controls, cathode follower output, mike or line input, and two circuit boards for easy construction and high stability. Complete instructions guide assembly.



**HIGH FIDELITY AM TUNER KIT**  
**MODEL BC-1A \$26<sup>95</sup>**

Designed especially for high fidelity applications this AM tuner will give you reception close to FM. 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. Your "best buy" in an AM tuner. Shpg. Wt. 9 lbs.



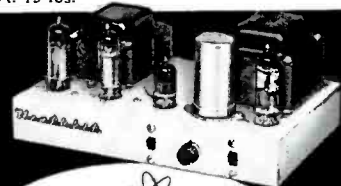
**MODEL FM-4**  
**\$34<sup>95</sup>**  
 (with cabinet)

**HIGH FIDELITY FM TUNER KIT (FM-4)**

The all new model FM-4 incorporates the latest advancement in circuit design. Features include better than 2.5 microvolt sensitivity for 20 db of quieting, automatic frequency control (afc) with defeat switch, flywheel tuning and prewired, prealigned and pretested tuning unit. Prealigned IF transformers and prewired tuning unit assure easy assembly with no further need of alignment after unit is completed. The five tube circuit features a generous power supply utilizing a silicon diode rectifier. Shpg. Wt. 8 lbs.

**"UNIVERSAL" 12 WATT**  
**HIGH FIDELITY AMPLIFIER KIT**  
**MODEL UA-1 \$21<sup>95</sup>**

Ideal for stereo or monaural applications, this 12-watt power package features less than 2% total harmonic distortion throughout the entire audio range (30 to 15,000 CPS) at full 12-watt output. Use with preamplifier models WA-P2 or SP-1 & 2. Taps for 4, 8 and 16 ohm speakers. Shpg. Wt. 13 lbs.



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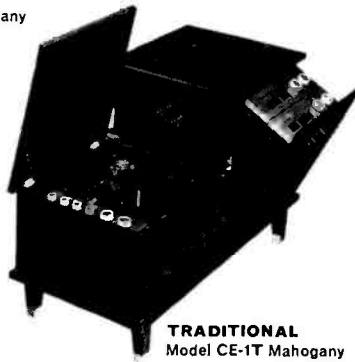
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Heathkit hi-fi systems are designed for maximum flexibility. Simple conversion from basic to complex systems or from monaural to stereo is easily accomplished by adding to already existing units. Heathkit engineering skill is your guarantee against obsolescence. Expand your hi-fi as your budget permits . . . and, if you like, spread the payments over easy monthly installments with the Heath Time Payment Plan.

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- No Woodworking Experience Required For Construction.
- All Parts Precut & Pre drilled For Ease of Assembly.
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**TRADITIONAL**  
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Control your complete home hi-fi system right from your easy chair with this handsome chairside enclosure in either traditional or contemporary models. It is designed to house the Heathkit AM and FM tuners (BC-1A and FM-3A) and the WA-P2 preamplifier, along with the RP-3 or majority of record changers which will fit in the space provided. Well ventilated space is provided in the rear of the enclosure for any of the Heathkit amplifiers designed to operate with the WA-P2. The tilt-out shelf can be installed on either right or left side as desired during the construction, and the lift-top lid in front can also be reversed. All parts are pre-cut and predrilled for easy assembly. The contemporary cabinet is available in either mahogany or birch, and the traditional cabinet is available in mahogany suitable for the finish of your choice. All hardware supplied. Shpg. Wt. 46 lbs.

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**DIAMOND STYLUS HI-FI  
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MODEL MF-1 **\$26<sup>95</sup>**

Replace your present pickup with the MF-1 and enjoy the fullest fidelity your library of LP's has to offer. Designed to Heath specifications to offer you one of the finest cartridges available today. Nominally flat response from 20 to 20,000 CPS. Shpg. Wt. 1 lb.

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SPEAKER SYSTEM KIT**

The SS-1B employs a 15" woofer and super tweeter to extend overall response of basic SS-2 speaker from 35 to 16,000 CPS ± 5 db. Crossover circuit is built in. Impedance is 16 ohms, power rating 35 watts. Constructed of ¾" veneer-surfaced plywood suitable for light or dark finish. Shpg. Wt. 80 lbs.



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



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**"BASIC RANGE" HI-FI SPEAKER SYSTEM KIT**



MODEL SS-2 **\$39<sup>95</sup>**

Legs: No. 91-26 Shpg. Wt. 3 lb. \$4.95

The modest cost of this basic speaker system makes it a spectacular buy for any hi-fi enthusiast. Uses an 8" mid-range woofer and a compression-type tweeter to cover the frequency range of 50 to 12,000 CPS. Crossover circuit is built in with balance control. Impedance is 16 ohms. Power rating 25 watts. Tweeter horn rotates so that the speaker may be used in either an upright or horizontal position. Cabinet is made of veneer-surfaced furniture-grade plywood suitable for light or dark finish. All wood parts are pre-cut and predrilled for easy assembly. Shpg. Wt. 26 lbs.

**LEGATO HI-FI SPEAKER SYSTEM KIT**

MODEL HH-1 **\$299<sup>95</sup>**


The startling realism of sound reproduction by the Legato is achieved through the use of two 15" Altec Lansing low frequency drivers and a specially designed exponential horn with high frequency driver. The special crossover network is built in. Covers 25 to 20,000 CPS within ± 5 db. Power rating 50 watts. Cabinet is constructed of ¾" veneer-surfaced plywood in either African mahogany or white birch suitable for the finish of your choice. All parts are pre-cut and predrilled for easy assembly. Shpg. Wt. 195 lbs.



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# AUDIO ETC.

Edward Tatnall Canby

## 1. PLAY RECORDS AND LIKE IT

As of this writing, I am five days' regular mail from home, two days' air mail, and the territory seems so wholly removed from the world of audio that I can scarcely get myself to write on that honored subject. But it is good for me, of course, to get away from the hectic center of things and see how records and hi fi look to the big outside world in its millions of small corners, of which this is one. Where am I? Not Pakistan, nor Durban nor even Yokohama, but just plain Tennessee. I got a letter this morning from Peter Bartok of Bartok records in New York that was mailed just seven days ago. That's how far away I am.

Down here, audio, hi-fi and records make a subject for an experiment in teaching which I believe is quite novel and perhaps untried to date. I'm teaching hi fi—plus sixteenth century motets—to an enterprising batch of budding professional musicians, average age about sixteen, who are being trained by a faculty of professional symphony players. The Sewanee Summer Music Center is encamped on a lovely old mountain campus, the University of the South, for five weeks of concentrated music-making—fiddle players, trombones, horns, bassoons, clarinets, oboes, each group ardently coached by the professional symphony specialist for the given instrument. When they rehearse, under a big tent on a very green and leafy lawn, these kids play manfully (and girfully) with a concentration that should make any teacher envious. They can't be stopped. They take their harmony lessons to the swimming beach with them and study between dips. They eat, drink, blow, scrape and pound music all day long.

It would make you envious too, I'm sure, if you happened to be thinking about the young engineering students whom you may know. These kids get up at five in the morning to practice, or stay out of bed surreptitiously until the wee hours, against camp regulations, to hide themselves in a sound-proof practice room and hammer away (or blow away) at their instruments.

No doubt about it, music—live music—is a vital, living thing for a surprisingly large number of upcoming young folks. They face up to the formidable, even terrifying complexities of skilled musical performance with the usual fortitude of youth, and more than that. They study and play, here, as though the world of the future would certainly be conquered by clarinets and bassoons, as though if only the right embouchure, the correct stance, the exact rhythm and lilt could finally be achieved by each and every one of them, the problems of nations and the nuclear bomb would

melt away. It's a nice feeling, a heartening one, if slightly provincial.

You see, if the United Nations and the Bomb don't get mentioned very often here, because there isn't time to bother with them and there's practicing to be done, work to fill every moment of a musician's life—then audio, too, seems generally distant and not so very important, all in all. Records are nice, of course, but real work, real music is so much more to the point—and practice, practice, practice; that's what *really* has to count. Records are like candy, and apt to make one sick if taken in more than tiny doses—sick for lack of music practice. Time is of the essence, and it's not for leisure—especially, listening to records.

To be sure, the bassoonist from the Pittsburgh Symphony who lives next door to me in the big stone college dormitory named Cleveland Hall, has a Magnavox and a cat. Each morning before our 7:30 breakfast he puts on one record, shaves, feeds the cat and rushes out to play bassoon. Each noon he comes back, plays a record, cleans up the cat's mess, if any (often), and rushes out to play bassoon again, or teach bassoon. Same, ditto, *idem*, various other times. He gets a surprising amount of music in, this way (hi-fi on records, I mean), though it is only natural that almost every piece he plays has a bassoon in it. (Bassoons play in practically all music, when you come down to it, so he has plenty to choose from.)

I brought down some 500 records, about four-fifths of them stereo, to represent the huge present recorded library. The rear end of my car practically hit the ground under the weight. I also crammed in a pair of AR-3 speakers and another pair of KLH Sixes—plus my complete Dynakit system and a spanking brand new Fisher 300 stereo outfit. Also mikes, tape, a four-track recorder, and other paraphernalia galore. You should have seen my packing job for the thousand-mile jaunt over the Blue Ridge Parkway!

Unfortunately I am not yet able to report very much on this lovely array of hi fi. I can state positively that the Fisher turned on and didn't blow a fuse, nor did it hum. I can say equally well that both the AR-3 speakers produced a large volume of sound. But beyond this I am presently stymied for two excellent reasons.

First, I have—inevitably—been assigned a fine, big university class room for my hi-fi lectures. It is the Devil's own first choice as the prize horror-room for listening. Unbelievable! Solid concrete, utterly rectangular, without one square inch of padding or sound deadening of any sort,

and one side is solid windows, the other sides mostly hard, shiny blackboards. Tile floor, varnished wooden chairs carved in flat planes. Phew! The sound that emanates from my speakers is vaguely like the rumble of a subway train on a sharp curve. If you listen hard, you can tell that it is music that is playing.<sup>1</sup>

The odd thing is (and I've noticed this before, in other similar situations) that in this hard, bright, utterly plane-surfaced room, what you hear is all bass and no highs. For a moment, I thought the AR-3's were connected with the tweeters out. Not at all; they were turned all the way up, both highs and mid-range. I managed to get a slight and relative improvement by—believe it or not—boosting the highs to the maximum and rolling off the bass all the way, plus the rumble cut-off set at a fairly drastic position.

Worst of all, it didn't seem to make really very much difference what I did with the controls, nor what I played. All records, including the deadead ones I know, sound ultra-live and thoroughly scrambled.

Two speakers. I tried to check their phasing via a mono record played through both—and found that it didn't make the slightest difference which way I set the polarity. The reverberation was so tremendous that every last vestige of phasing was effectively blurred out. Stereo? Here I had brought a thousand-odd dollars' worth of stereo equipment all the way to this blasted room and I immediately found that in it there was not the slightest audible difference between stereo and mono sound—phasing quite aside!

It's an odd spot for an audio man to be in, but not actually an unusual one, come to think of it. Don't forget that records, most providentially, sound decidedly at their best in the acoustics of the average home living room—indeed, they are tailor-made for the living room and generally find themselves painful misfits in most other acoustics. Class rooms, lecture halls, student lounges and the like are *not* designed for record listening and no reason why they should be. But unfortunately, if one is to give illustrated lectures on records, with records, the class room is the place it ordinarily has to be done. You members of local hi-fi clubs will know all too well what I mean. Have you found a really good place to hold your musical meetings—one that will hold the audience and treat the recorded sound rightly?

The physical blur of recorded music in my class room (I've been spending today trying to locate a replacement room somewhere else) is compounded by the second reason for a slight delay in producing results here in this Tennessee music camp. (I haven't been here very long yet.) That is, of course, the musicians themselves.

My job, ever so tactfully, is to persuade these excellent, ardent, hard-working live musicians that recorded music has something to do with their lives. And, as of now, I have to do my persuading in *that* room. Ugh.

So my very first problem of all, is to find a better listening place. People here, like others everywhere, do not understand what a whale of a difference room acoustics can make—do make—in reproduced sound. Not

<sup>1</sup> Why didn't you open the windows? Ed.



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The AR-3 is a three-way speaker system combining an AR-1 acoustic suspension woofer with two high-frequency units developed in AR's laboratory over the last year.



Like the AR woofer, the tweeters used in the AR-3 represent a radical departure from conventional speaker design, and patent application has been made.\*

These new tweeters are neither cone-type nor horn devices—they could be described technically as hemispherical direct-radiators. We believe that their uniformity and range of frequency response, their low distortion, and their transient and dispersion characteristics establish new performance standards, and that the AR tweeters make a contribution to treble reproduction similar in degree to that made by AR's acoustic suspension woofer to bass reproduction.

The AR-3 has the most musically natural sound that we were able to create in a speaker, without compromise.

\*Patent applied for by E. M. Vitichur, assignor to Acoustic Research, Inc.

# AR-3

The AR-3 speaker system, complete with the necessary "bookshelf" size enclosure, is \$216 in mahogany or birch—prices in other woods vary slightly. Literature on the AR-3 is available for the asking.

**ACOUSTIC RESEARCH, INC.** 24 Thorndike St., Cambridge 41, Mass.

even enough engineers understand it. Most of us are lucky; our living rooms, by the happy chance of current decorating styles, are usually quite good for recorded sound. A few years ago, many a living room was too dead for listening comfortably, what with rugs, pillows, heavy drapes, plush sofas. Now, the modern trend has brought in more hard furniture, less absorbent drapery and upholstery. But it hasn't gone so far as to leave our living rooms bare and chilly, like the average classroom! Not that.

To be sure, there's a marvelous listening room up our University avenue a ways, in a comfy old fraternity house with all sorts of nooks, balconies, wooden paneling, carpets, a peaked roof. Superb—but it happens to be in the Director's private home and isn't properly available. There's chamber music to be played there all day long (and what a lovely sound), with small time left for any other purpose. But ah! what a lovely sound from a stereo tape, too, that I played in there the other evening! I'm going to have to wangle my way into that room willy-nilly unless I can find its double somewhere else.

(There surely is nothing like putting your theories to the test. I'm testing my pet ideas on recorded sound with a vengeance here.)

But back to the musicians. The bassoon, the clarinet, the horn are simply too busy to spend their lives learning about records and, as specialists in a very demanding art I cannot in the least blame them. There's work for them to do and no end to it, ever. But what makes things more interesting is that some other faculty members among these musicians are a lot more than merely indifferent to the joys of record listening and the complexities of audio acoustics, stereo and what-not. These others, like many musicians the country over, actively distrust, even hate recorded music. They feel, and have told me so elsewhere as well as here, that records are not only murderous to the actual sound of real music but, more important, they are passionately convinced that recorded sound has already threatened the entire art of music and is well on its way towards killing off the musicians himself and his livelihood. Records, from this musician's point of view, are an ominous force that is undermining their whole way of life. Audiences are vanishing from their concerts, young people find jobs elsewhere, musicians are quitting by the hundreds, disillusioned, standards of playing are going down . . . it's a dismal story to hear, and it does make you pause to think.

Here I am, an enthusiast for this very enemy of theirs, right in their own camp—teaching their own young musical hopefuls all about records! It's a bit hard on the musicians and not too easy for me, though it is a tremendous challenge to see whether I can't convince some of these pleasant people here that neither I nor my records and my hi-fi are here to bite them, so to speak. In a microcosm, on this campus, we have the very essence of the musician's problem today. The situation, if it weren't so real, so isolated, so intense, could be tremendously interesting for all of us—and probably will be before I leave.

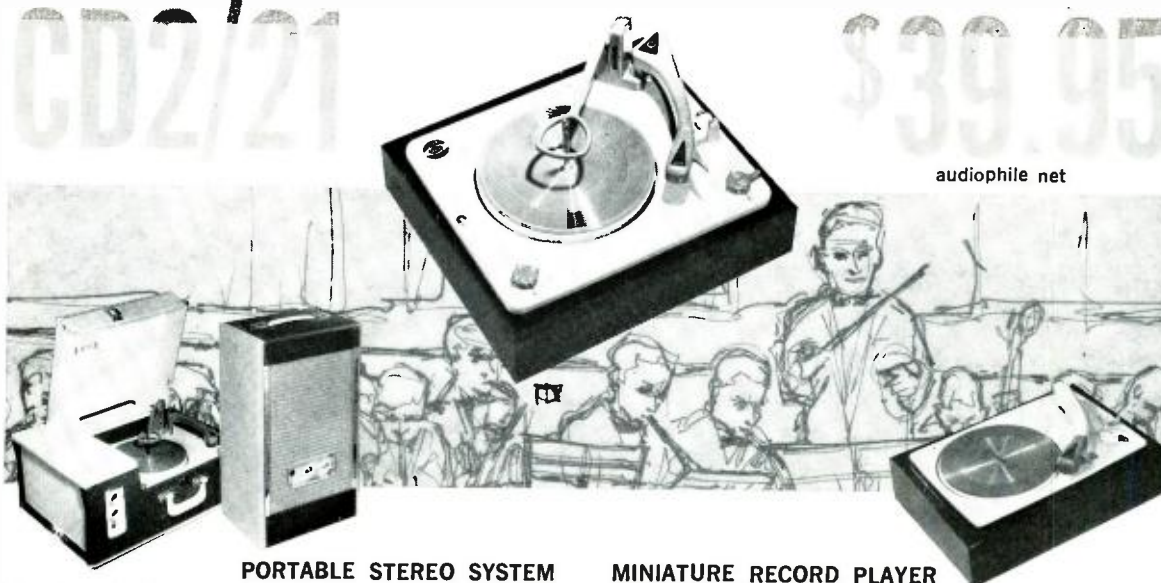
The problem I face, of course, is not how to solve these musicians' future for



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them, which I can't do, but simply to get their attention. There aren't many arguments because everybody is much too busy to argue—even the bassoonist with his Magnavox. He plays records but he's not interested in them as records, nor how they work. He just wants to hear the music on them. An admirable idea and, I must confess, a rather pleasant one for me, who spend most of my time trying to persuade hi-fi fans to pay more attention to music and less to the cycles and the IM distortion.

And I confess, too, that my own resolution is hard put, here. I tend in this intense area of active music-making to lose interest in my own records. I, myself, *want* to hear this live music; I am almost apologetic when I suggest that maybe the students ought to have a few hours now and then during which they could listen to my 500 discs and study what other musicians are doing in the great, big outside world.

But I mustn't be apologetic. I tell myself that records *are* here to stay, that audio is a great, big field unto itself, that hi-fi, for all its goofiness, is a big industry and an even bigger cultural force in our life today. I assure myself, privately, that millions of people are interested in records and in hi-fi, that an enormous new audience for music has been created by the phonograph, that recording has revived vast areas of long-forgotten art that would never have been heard again were it not for the art of sound reproduction.

I insist, to myself, that I am representing, here in the mountains of Tennessee, one of the most dynamic artistic movements of our century, just as I am in this magazine that you are now reading.

But it all seems very distant, in spite of me. Last night I forsook my tape recorder and went off to listen to Stravinsky, played by seven of my new musician friends here. It was terrific and lots better than any record. This afternoon, the next-door bassoonist spent three hours teaching a lovely young lady student how to cut her own bassoon reeds. I was fascinated, for here was old-line craftsmanship of a sort you wouldn't believe could still exist. Each of his double reeds is cut and shaped by hand with a careful knife, the edge trimmed to a millimeter, the thickness carefully scraped down for hours to an exactly even taper and a perfectly symmetrical curve. The canes for the reeds grow only in one part of France—they can't be had anywhere else. They last a week or so, and then the bassoon (and oboe) player spends more hours of handwork scraping and binding another.

Sure, it's like building a hi-fi kit in a way; but suppose you had to go out and make your own resistors and capacitors, draw your own copper wire and wind on the insulation.

It's an interesting corner of the musical world, here in Sewanee, and no two ways about it. But I haven't yet been able to play a single record all the way through—anywhere on the campus. I'm not really sure I want to, at that. . . . *Phew! What am I saying?*

On with the Great Crusade, Canby. Get out and teach these musicians to play records and like it!

*(Continued on page 64)*

# New Stereo Tape Recorder Cybernetically engineered for intuitive operation

Fluid smooth, whisper quiet...with feather-light touch you control tape movement with the central joystick of your Newcomb SM-310. This exciting new stereophonic record-playback tape machine has been cybernetically engineered to fit you. Intuitively, you sense how to operate this handsome instrument. The natural movement, you find, is the correct movement. Loading is utterly simple. It is almost impossible to make a mistake. The transport handles tape with remarkable gentleness, avoids stretch and spilling.

The Newcomb SM-310 records stereophonically live from microphones or from broadcast or recorded material. There are

mixing controls on both channels for combining "mike" and "line." The SM-310 records and plays back half-track monaural also. So versatile is the machine that you may record and playback on either or both channels in the same direction.

The SM-310 is a truly portable unit which combines the features required by the professional and desired by the amateur for on-location making of master stereo tapes. For example, the SM-310 takes reels up to 10 $\frac{1}{2}$ " has two lighted recording level meters arranged pointer-to-pointer for ready comparison without repeating on any size reel. For playback there are a "balance" control and a

ganged volume control. Head cover removes, giving direct access to tape for easy editing.

The Newcomb SM-310 is a sleek, rugged, compact machine, discreetly styled by an eminent industrial designer in easy-to-live-with shades of warm gray and satin aluminum...a gratifying, precision instrument for the creative individual who is deep in the art of tape recording. Eight, tightly-spaced pages are required in a new brochure to describe the SM-310 in detail; send for your free copy.

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# EDITOR'S REVIEW

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## AUDIO ENGINEERING SOCIETY CONVENTION

**W**ITH THE PRESENTATION of papers from all over this country as well as from Europe and South America, the Eleventh Annual Convention of the Audio Engineering Society will take place at the Hotel New Yorker October 5th through the 9th. These papers will cover the newest theories, developments, and achievements in the audio field, and will include a thorough discussion of stereo. There will be a broad coverage of sound recording and reproduction.

The convention will be accompanied by the second "noiseless" exhibit of professional audio equipment, first introduced last year, and it is expected that the number of displays will triple those of last year. Technical sessions will be presented on a three-a-day basis commencing at 9:00 a.m. on October 5, and the annual banquet and presentation of awards will follow the cocktail party on Thursday, October 8.

Beginning on the same day and continuing for one day after the AES Convention closes, the New York High Fidelity Show will take place across the street from the New Yorker in the Trade Show Building—but will most certainly not be "noiseless." People who come to see high fidelity equipment expect to hear it also.

## THE WEST COAST SHOWS

The Institute of High Fidelity Manufacturers has just announced the dates and locations for the San Francisco and Los Angeles Shows. In the Bay City, the location is Brooks Hall at the Civic Center, and the dates are January 27 to 31.

The Los Angeles show follows a few days later, opening at the Shrine Exposition Hall on February 10 and continuing through the 14th.

We will have further information about these two important shows during the next few months—you will still have plenty of time to arrange for your annual early-spring trip to the coast. In the meantime, there are the Rigo shows in many of the smaller cities—nearly one a week throughout the fall season—along with the Chicago and New York shows—the former at the Palmer House from September 18–20, and the latter October 5–10, as mentioned above.

Paraphrasing the boast of the Philadelphia paper that "nearly everybody reads the *Bulletin*," we believe it is safe to say that "nearly everybody goes to the New York Show"—at least that is what you think when you are there.

## CONSUMER MAGAZINES

Apparently we are not alone in deriding the supposed omniscience of consumer testing organizations—the somewhat less than austere *Punch* had its innings in the January 14 issue, a copy of which we just received from Gilbert Briggs. *Punch* "analysed" copies of *Which?* and *Shopper's Guide*, England's two consumer "guidance" journals.

This is one time we beat *Punch* to the punch—if you remember our editorial of April, 1957. And we have never had cause to change our opinion since.

## MONODIC

Turning to another British publication, we find this interesting bit in the June issue of *Wireless World*. A chap writing under the *nom de plume* of "Free Grid" conducts a page each month titled UNBIASED, and his lead article studies the language to find a really good word for single-channel reproduction. He believes the correct word is "monodic," after agreeing that *monaural* is more offensive than *monophonic*, which is just plain dreadful. Cause of it all was BBC's patronage of *monophonic*—which most of us use in this country as an improvement over *monaural*, and which is officially accepted by the IHFM. *Monodic*, by the way, is a contraction of *monos* (one or single) and *hodos* (a way, path, or channel). Still quoting from *Wireless World*, we find that in such combinations the "h" is usually dropped, as in *electrode*.

The funny part comes when Free Grid attempts to find the right word for two stereo channels sharing the same radio channel—as in multiplex. He claims the word should be *homodic*—same channel—but he expects it to become known as *homostereo* to distinguish it from stereo broadcasting on two separate channels which might be called *heterostereo*. He concludes by expecting that the Yanks—that's us—will probably fuse Latin and Greek and call it *solo stereocasting*.

All of which proves that there are many ways to have fun—but most of us never went to Oxford.



**"IT TAKES TWO TO STEREO" \***



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**"THE NATIVE HOLLANDER WEARS WOODEN SHOES."**

### *A Bell Telephone Laboratories experiment in noise appraisal*

"The native Hollander wears wooden shoes."

"Nebraska has no seacoast."

"The daisy is a common wildflower."

As these syllables, words and sentences come in over the telephones, stand-ins for millions of Bell System subscribers rate them for clarity of reception.

From these tests, Bell Telephone Laboratories engineers determine what is objectionable noise, and work to minimize it in telephone circuits. They begin by tape recording background noise associated with working telephone circuits. Test statements of appropriate length and content (such as those above) are read onto a second tape, and both are fed onto the test circuit under carefully controlled conditions. A third tape, of normal room noise, is played through a loudspeaker in the test lab.

Several hundred listeners, meeting in small groups several times a day for weeks at a time, are then asked to rate the effect of noise on transmission of the various simulated telephone calls.

For the Bell System, the results of the study will become part of the over-all transmission objectives. At Bell Laboratories, they will influence apparatus and systems development work.

Noise is a major distraction of modern day living. It is also an enemy of the Bell System. In a telephone receiver during a call, it might be power line hum, switching or thermal noise, or perhaps atmospheric static. Bell Laboratories spends a great deal of time, effort and money to keep this extraneous noise from becoming annoying and to assure you of a trouble-free connection.



**BELL TELEPHONE LABORATORIES**

*World center of communications research and development*

# Transistor Music System Using Direct Coupling

RICHARD S. BURWEN\*

Using 13 transistors with direct coupling and 57 db of negative feedback results in only .01 per cent low-frequency harmonic distortion in a 20-watt class B battery-operated power amplifier. The 11-transistor control unit uses three direct-coupled feedback amplifier sections to provide phono equalization, tone controls, a four-channel mixer, and speaker equalization.

**D**ISTORTIONLESS PERFORMANCE in transistor audio equipment requires a great deal of negative feedback. Direct coupling makes possible the use of large amounts of stable feedback in the music system to be described.

Three matched components comprise the system: a 20-watt power amplifier, a tone-control preamplifier, and a speaker system. Battery operation and compact construction make the system suitable for both home and portable use. To produce over-all pleasing sound and wide acoustic frequency response, fixed equalization which compensates for speaker system inefficiency at the extremes of the audio range is incorporated in the tone control preamplifier unit.

## Power Amplifier

The power amplifier, *Fig. 1*, delivers 20 watts to an 8-ohm load with an input of 0.4 volts rms into 3300 ohms. Identical 55-watt power transistors, direct coupled to the load, are mounted at the upper left on a bracket which conducts

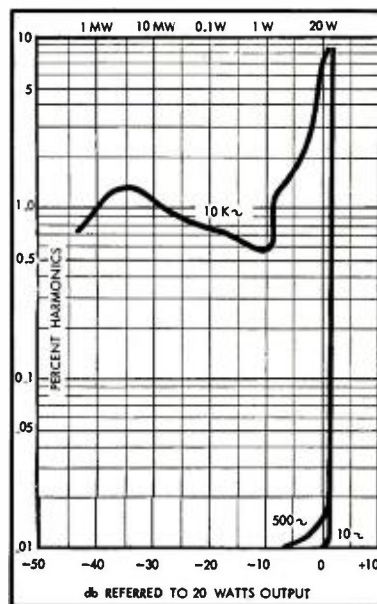
\* Boston Division, Minneapolis-Honeywell Regulator Co.

their heat to the main chassis. The only controls are on and off push buttons which operate a latching relay. Not shown are four mercury flashlight-size cells and a 45-volt battery somewhat larger than the 8" x 6" x 3½" aluminum chassis.

In order to minimize the battery drain and internal heat the output stage is operated in class B with an efficiency of 69 per cent at maximum sinusoidal output. Since the average power input when reproducing speech and music is much smaller than for steady signals, the average current drain per hour may be as low as 40 ma at 45 volts while 2.2-ampere peaks are being delivered to the load occasionally. The current drain at no-signal is only 27 ma.

As a result of the low average power input, battery life is between 10 and 100 hours depending upon how loudly music is played. Smaller batteries can be used when reduced life is acceptable, but the power output is reduced because of their lower output voltage at high currents.

Although capable of only 40-watt undistorted peaks the amplifier can fre-

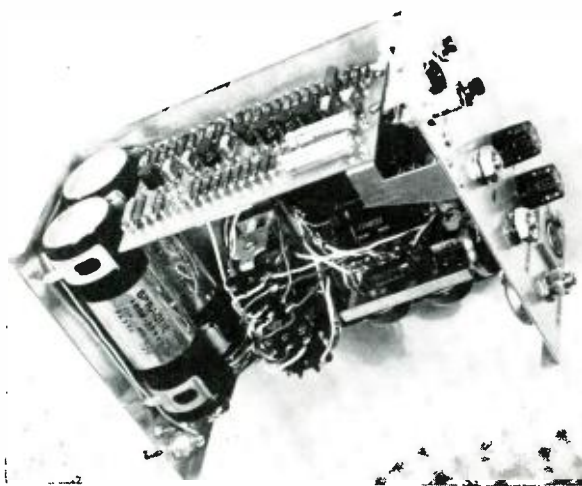


*Fig. 2.* Power amplifier total harmonic distortion vs. power output at 10, 500, and 10,000 cps

quently be operated under overload conditions with remarkably good results. Its sharp overload characteristic and its practically instantaneous recovery when the input signal is reduced below the clipping level minimizes the audible effect of overload during occasional peaks.

When used as a speech clipping amplifier feeding the associated speaker system, the input signal may be increased as much as 10 db above the overload point with little audible distortion on speech. Since the missing peaks do not noticeably affect the average loudness, the effective output is that of a 200-watt amplifier. Thus as a portable public address amplifier it has tremendous power.

When reproducing music fairly clean-sounding signals can be delivered at effective outputs between 40 and 200 watts depending upon the low-frequency content of the program material. Over-



*Fig. 1.* 20-watt direct-coupled transistor power amplifier.



loaded bass notes generally are intolerable whereas cymbals and brass instruments may sound undistorted when the amplifier is delivering square waves 30 per cent of the time. The maximum increase in audible output when the amplifier is delivering square waves nearly all the time and sounds very distorted is about 13 db.

### Direct Coupling

Except for one coupling capacitor at the input all 13 transistors in the schematic, Fig. 3, are direct coupled. The input transistor  $Q_1$  is a low-noise emitter-follower needed to drive the high input capacitance of  $Q_2$ , a PNP common-emitter amplifier.  $Q_1$  also compensates changes in the base-to-emitter voltage of  $Q_2$  with temperature by means of the opposite change in its own base-to-emitter voltage.  $Q_2$  has a very high voltage gain of 2500 obtained by using an extremely high collector load impedance. This load impedance consists of the high collector impedance of the NPN transistor  $Q_3$  which is further increased by emitter degeneration.  $Q_4$  and  $Q_5$  are emitter-followers used to minimize the loading on  $Q_3$ , provide a low output impedance, and by means of a voltage divider reduce the d.c. output level to approximately ground potential.

This combination of three emitter-followers and one common-emitter stage has a total voltage gain of 1800 at low fre-

quencies with phase shift at high frequencies approaching that of only one stage. In the megacycle region, the direct signal path through the base-to-emitter capacitance of the emitter-followers reduces their phase shift and helps stabilize the over-all feedback loop.

Following  $Q_5$  are four stages of push-pull class B amplification  $Q_6$  through  $Q_{12}$ . Except at the common input and common output there is no connection between the sides of the four push-pull stages. Both power transistors  $Q_{12}$  and  $Q_{13}$  are of the same 55-watt PNP type. Push-pull operation is accomplished by a series connection with  $Q_{12}$  powered by -22.5 volts and  $Q_{13}$  by +22.5 volts. In order to establish the proper d.c. levels and driving voltages the sequence of NPN and PNP stages driving  $Q_{12}$  is different from the sequence driving  $Q_{13}$ .

In the upper section of the circuit stages  $Q_6$ ,  $Q_7$ ,  $Q_8$ , and  $Q_{12}$  all conduct at the same time to deliver negative output signals at  $J_{51}$ .  $Q_6$  and  $Q_7$  are common-emitter stages while  $Q_8$  and  $Q_{12}$  are emitter-followers. In the lower section of the circuit  $Q_9$ ,  $Q_{10}$ ,  $Q_{11}$ , and  $Q_{13}$  all conduct at once to deliver positive output signals. Common-emitter stage  $Q_9$  is followed by two emitter-followers  $Q_{10}$  and  $Q_{11}$  and then the final common emitter stage  $Q_{13}$ . Since there are two stages in each section that invert phase and two stages that do not, the output signals from  $Q_{12}$  and  $Q_{13}$  are in phase, re-

sulting in true push-pull operation with identical output transistors.

Examining the circuit more closely,  $Q_5$  feeds directly the base of the common emitter PNP transistor  $Q_6$  and through two biasing diodes the base of the NPN common-emitter transistor  $Q_9$ . The collector signals of  $Q_6$  and  $Q_9$  are in phase but referenced to different d.c. supply voltages.  $Q_6$  then feeds a three-stage feedback amplifier  $Q_7$ ,  $Q_8$ , and  $Q_{12}$ . Common emitter NPN transistor  $Q_7$  delivers a low-current signal centered near ground potential with a swing of  $\pm 18$  volts. Emitter-follower  $Q_8$ , capable of 100 ma output, drives emitter follower  $Q_{12}$  to deliver 2.2 ampere peaks to an 8-ohm load connected between  $J_{51}$  and  $J_{52}$ .

In the lower section,  $Q_9$  feeds emitter-followers  $Q_{10}$  and  $Q_{11}$  which amplify the signal current to provide up to 100 ma drive for the common-emitter output stage  $Q_{13}$ . Only  $Q_{13}$  has a large collector swing.

For push-pull class-B operation at low distortion only one output transistor must conduct at a given time except during a small overlap region which is necessary to prevent crossover distortion. When  $Q_{12}$  is conducting its current output per volt delivered by  $Q_5$ , or transconductance, must equal the current delivered by  $Q_{13}$  when it conducts. At crossover each transistor should contribute one-half the total output signal

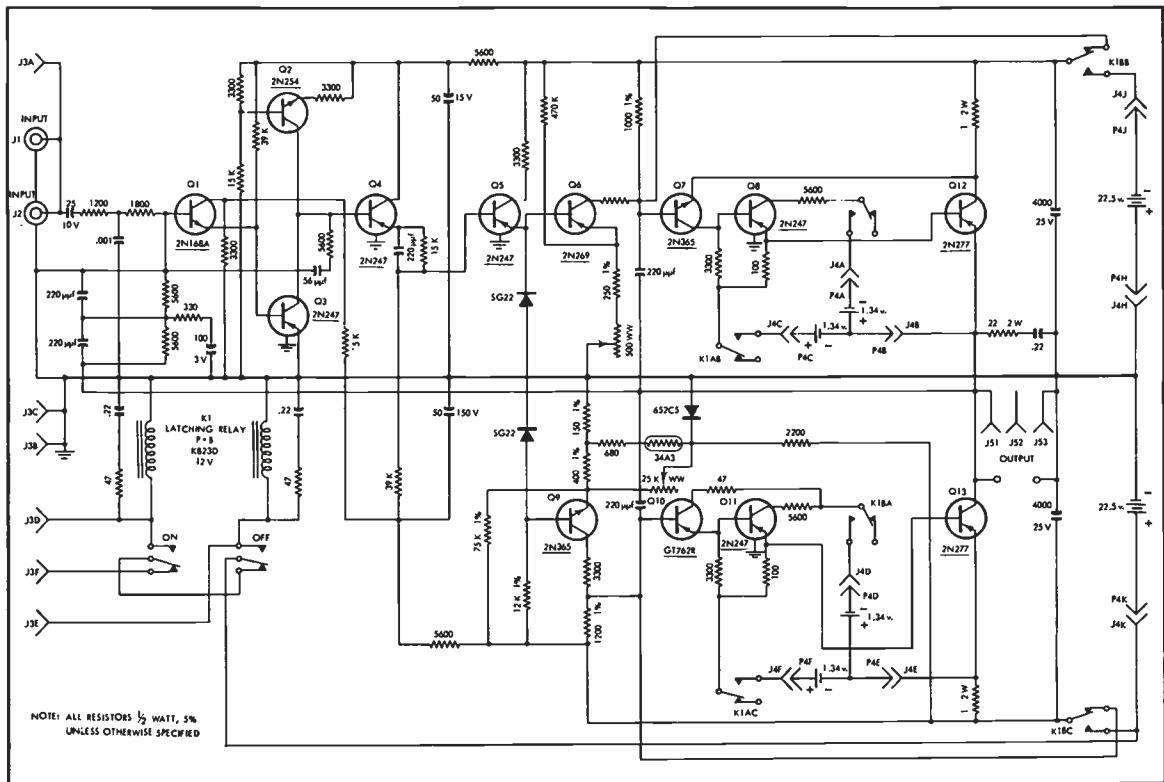


Fig. 3. Schematic of power amplifier.

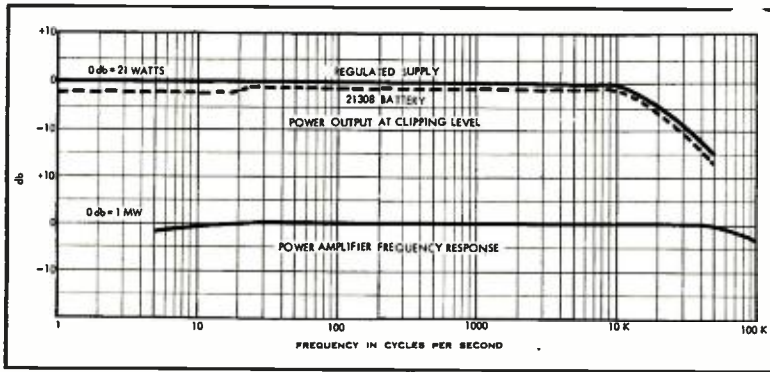


Fig. 4. Power amplifier maximum power output and low-level frequency response.

current and the total transconductance should be the same.

These conditions are met by establishing the operating points and gains by means of local feedback. Emitter degeneration stabilizes the voltage gain of  $Q_6$  at 1.8 and that of  $Q_9$  at 2.2. Local feedback developed by the collector current of  $Q_{12}$  across a 1-ohm resistor in series with the emitter of  $Q_7$  stabilizes the combined three-stage transconductance of  $Q_7$ ,  $Q_8$  and  $Q_{12}$  at 0.83 amperes per volt. The total transconductance referred to the emitter of  $Q_5$  is then 1.5 amperes per volt, resulting in a voltage gain of 12 to an 8-ohm load. Similarly local feedback developed by the emitter current of  $Q_{13}$  across a 1-ohm resistor in series with the emitter of  $Q_{10}$  (and the small base-to-emitter voltage of  $Q_{11}$ ) stabilizes the three-stage transconductance of  $Q_{10}$ ,  $Q_{11}$  and  $Q_{13}$  at 0.68 amperes per volt. Referred to the emitter of  $Q_5$ ,  $Q_{13}$  also delivers 1.5 amperes per volt. A 500-ohm adjustment in series with the emitter of  $Q_6$  permits precise matching of these transconductances.

Because of the low voltage gain the normal tendency toward a simultaneous increase in the two output-stage collector currents with increased temperature is minimized. Residual drift is compensated to within  $\pm 10$  ma for ambient temperatures of 32° to 120° F by means of diodes and a thermistor which vary the bias on  $Q_6$  and  $Q_9$ . These diodes also form part of a network used to change the bias in accordance with battery voltage variations so as to maintain constant the output-stage no-signal collector current as either the +22.5 volts or the -22.5 volts decreases to as low as 12 volts.

Drift of the output voltage due to unbalance in the collector currents of  $Q_{12}$  and  $Q_{13}$  is prevented by additional overall feedback amounting to 57 db at audio frequencies and 87 db at d.c. This feedback from the output  $J_{51}$  to the base of  $Q_1$  holds the output signal at nearly the base potential of the first stage. The base potential is in turn determined by the very small base-to-emitter voltage of  $Q_1$  plus that in  $Q_{12}$ , both of which vary with

temperature but in opposite directions so that they cancel.

Stabilization of the feedback is accomplished at high frequencies by means of local feedback paths from the output  $J_{51}$  through small capacitors to the base circuits of  $Q_7$  and  $Q_{10}$  and from the col-



Fig. 5. Left: Overloaded power-amplifier output at 1000 cps. Right: output vs. input under the same conditions.

lector of  $Q_9$  to the base of  $Q_1$ . Shunt capacitors provide phase lead in the main feedback network to help stability.

Four 1.3-volt flashlight-size mercury cells power  $Q_8$ ,  $Q_{10}$ , and  $Q_{11}$ . To prevent



Fig. 6. Power-amplifier square-wave response

a condition during the application of power in which both output transistors are conducting heavily a latching relay K1, modified for make before break operation, turns on the bias voltages before the high voltages. The relay can be

turned on and off by either local or remote control push-buttons.

### Performance

At low frequencies, where the greatest power output is needed to overcome speaker-system inefficiency, the performance of this amplifier is outstanding. Figure 2 shows curves of total harmonic distortion versus power output to an 8-ohm load at 10,500, and 10,000 cps when using a regulated power supply. At 10 cps the distortion is less than 0.01 per cent at the full 20 watts output and at 500 cps only 0.014 per cent.

Due to the limitation in the rate at which the power transistor collector currents can be cut off the maximum power output decreases above 10,000 cps. This factor together with the reduction in feedback for stability reasons to only 18 db at 20 kc results in a total harmonic content between 0.5 and 2 per cent on 10,000-cps signals up to 10 watts output. Since less power output is needed at the high frequencies in normal reproduction, and the principal harmonic content is beyond the range of audibility, the increased distortion is of no consequence.

Maximum power output at the clipping level as a function of frequency is shown by the upper solid line in Fig. 4 when using a regulated supply. Slightly less output, shown by the dotted curve, is obtained when using battery power because the voltage decreases at high currents. A pair of 4000-microfarad energy storage capacitors tends to hold up the battery voltage during current peaks, permitting sustained sinusoidal outputs of 19 watts above 40 cps and instantaneous peaks of 42 watts when reproducing music and speech.

When overloaded the amplifier clips cleanly and symmetrically as in Fig. 5 and recovers to its normal low distortion state within 30  $\mu$ sec after the input signal is reduced below the overload point. The residual delay in the recovery seems

Fig. 7. Battery-powered control unit has phono preamplifier, four channel mixer, and tone controls.



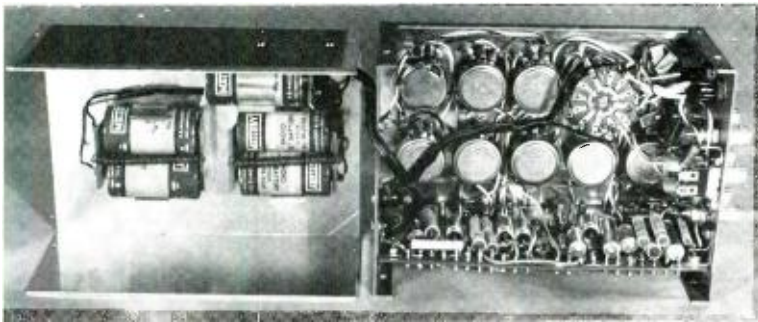


Fig. 8. Inside the tone-control preamplifier.

to be inherent in feedback circuits that saturate and is minimized by making the high-frequency loop gain high.

At low levels the frequency response shown by the lower curve in Fig. 4 is flat within 1 db from 10 to 70,000 cps. The corresponding square-wave response, Fig. 6, indicates low phase shift and freedom from ringing.

#### Tone-Control Preamplifier

The control unit, Figs. 7 and 8, operates from six self-contained 4-volt mercury batteries having a life of 1000 hours. It provides complete facilities for single-channel reproduction: a four channel mixer for TAPE, RADIO, PHONO, and dynamic MICROPHONE; a master VOLUME control; BASS and TREBLE compensators; a MONITOR control for monitoring

the tape while recording; an ON-OFF switch, and ON-OFF push-buttons for remote control of the power amplifier. The PHONO input has a low-noise preamplifier designed for ESL low-impedance cartridges. When the tone controls are set at their flat positions the output to the power amplifier is equalized to complement the response of the speaker system while the output for tape recording is flat. The tone controls operate on all channels except MONITOR. The normal signal level at the TAPE OUTPUT is 0.3 volts rms and at the main OUTPUT is 1 volt rms. Each output has 100 ohms internal impedance and is capable of feeding loads of 3300 ohms or higher through as much as 1000 feet of cable. Noise and distortion are extremely low.

Input levels are: 1 volt rms into 50 k ohms at the TAPE input, 3 volts rms into

300 k ohms at the RADIO input, 10 mv rms into 320 ohms for 10 cm/sec recorded velocity at the PHONO input, and 10 mv rms into 1000 ohms at the MICROPHONE input. The MICROPHONE input will accommodate dynamic microphones having an impedance of 30 ohms or higher. Full output from the power amplifier is obtained when the master VOLUME control is turned 18 db below maximum. Connections for the four inputs, TAPE OUTPUT, main OUTPUT, and power amplifier remote control cable are on the side of the control unit. An additional connector allows a check on the battery condition without opening the case.

#### Feedback Circuitry

Three separate direct-coupled feedback amplifiers constitute the tone control preamplifier shown schematically in Fig. 9. By powering each amplifier from its own positive and negative 4-volt batteries, decoupling problems and power-line noises are eliminated. Each amplifier has from 30 to 60 db of feedback around its output stage over the range of 20 to 20,000 cps to hold its distortion to a low value.

The first amplifier section is a three-transistor phono preamplifier,  $Q_1$ ,  $Q_2$ , and  $Q_3$ , providing gain and RIAA equalization for the magnetic pickup. Wide-band low-leakage r.f.-type transistors are  
(Continued on page 58)

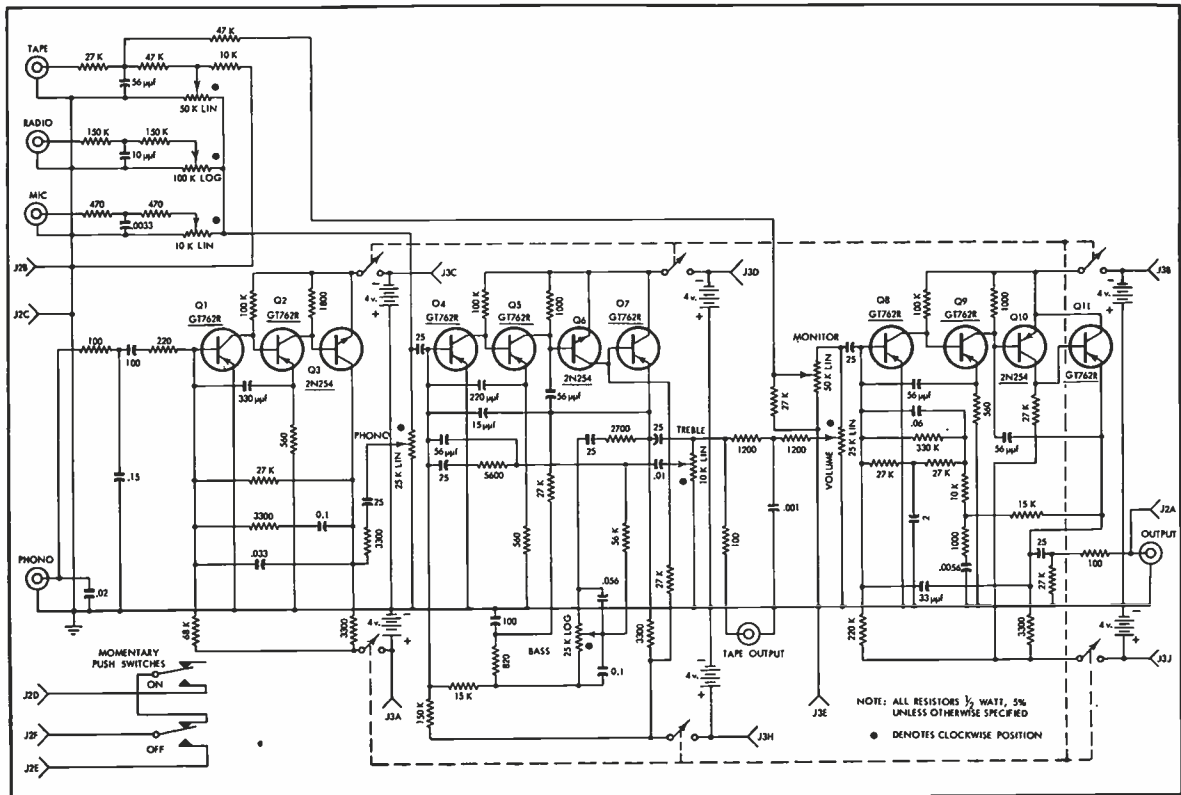


Fig. 9. Tone-control preamplifier schematic.





Rockbar introduces a remarkable new 4-speed Collaro transcription stereo changer—The Constellation, Model TC-99. The TC-99 offers tested and proven professional turntable performance with the advantages of automatic operation — truly a *complete*

record player for the connoisseur. Here are some of the features which make this the outstanding changer on the market today: **Performance specifications exceed NARTB standards for wow, flutter and rumble • Extra-heavy, die cast non-magnetic turntable weighs 6½ lbs. • Extra-heavy duty precision-balanced and shielded four pole motor • New two-piece stereo transcription type tone arm • Detachable five terminal plug-in head shell • Each model is laboratory checked and comes with its own lab specification sheet. Flutter is guaranteed not to exceed .04%. Wow is guaranteed not to exceed .15%. Rumble is guaranteed down -50 db (at 120 cps relative to 5 cm/sec at 1 KC).** The extra-heavy weight turntable is a truly unique feature in a changer. This extra weight is carefully distributed for flywheel effect and smooth, constant rotation. The non-magnetic turntable provides a reduction in magnetic hum pick-up of 10 db compared with the usual steel turntable. The heavy duty four pole motor is precision-balanced and screened with triple interleaved shields to provide an additional 25 db reduction in magnetic hum pick-up. The rotor of the four pole motor is specially manufactured and after grinding, is dynamically balanced to zero. While this is basically a turntable for transcription performance, a fully automatic intermix changer, similar to the mechanism employed in the famous COLLARO CONTINENTAL, MODEL TSC-840, is an integral part of the unit. **ADDITIONAL FEATURES:** New two-piece stereo transcription type tone arm with detachable five terminal plug-in head shell. This new arm is spring damped and dynamically counterbalanced to permit the last record to be played with the same low stylus pressure as the first. Between the top and bottom of a stack of records there is a difference of less than a gram in tracking pressure—compared with four to eight grams on conventional changers. Vertical and horizontal friction are reduced to the lowest possible level. These qualities—found complete only in Collaro transcription changers—insure better performance and longer life for your precious records and expensive styli. The TC-99 handles 7", 10" and 12" records—in any order. The changer is completely jam-proof and will change or play records at all four speeds. The manual switch converts the changer into a transcription type turntable providing transcription performance for the playing of a single long-play stereo or monophonic record. The two-piece arm can then be set down to play portions out of rotation or the entire record can be played singly and sequentially. The *double muting switch* provides absolute silence for both stereo channels during the change cycle and the R/C network helps to squelch "pop," "clicks" and other noises. The TC-99 comes complete with two audio cables ready to be plugged into your stereo system. It is pre-wired for easy installation; styled in a handsome two-tone ebony color scheme to fit any decor; tropicalized against adverse weather and humidity conditions. Long service life is assured by the automatic disengagement of the idler wheel preventing development of bumps and wow. Price of the TC-99 is \$59.50, exclusive of the base. All prices are slightly higher in the West. For free colorful catalog on the complete line of Collaro Stereo Changers write Rockbar Corporation, Dept. 100, Mamaroneck, N. Y.

***The last word in a Transcription Stereo Changer...***



***Collaro Constellation, TC-99***

# Hi-Fi Speaker Enclosure Damping Materials

JAMES A. HUFF, JR.\*

A report on a series of tests made to compare relative performance of three types of damping materials in speaker cabinets.

**T**REMENDOUS GROWTH in the production of high fidelity equipment has accentuated the need for more information on speaker-enclosure damping materials. Cabinet damping techniques vary widely. Materials recommended for this purpose range from brick and sand to a wide variety of fabricated products used in the building industry.

For the manufacturer who wishes to select a damping material there is limited information. On the other hand, tone-conscious hi-fi enthusiasts, alert to the refinements possible in their sets, are often frustrated in their attempts to achieve cleaner sound.

Throughout the industry, millions of dollars have been spent in laboratory research on amplifiers, preamps, turntables, pickups, speakers and enclosures. Results of this research have made top-quality components available to the consumer, each especially designed for the hi-fi market.

The speaker system still remains, however, the weak link in hi-fi installations. This is due in large part to the fact that damping materials inside the cabinet have been given too little attention.

A critical look at present damping materials therefore is in order. This report is a step toward examining, comparing, and developing data on three damping materials having good acoustical properties.

## Cabinets and Damping

Sound from the back of a speaker cone is 180 deg. out of phase with the sound from the front. Under certain conditions of path length (front to back) and frequency they will cancel. This cancellation causes dips and peaks in the speaker output. By mounting the speaker in a cabinet, however, the back wave is confined within the enclosure and cancellation cannot occur.

At the same time, enclosing the speaker in a cabinet poses problems of cabinet radiation, cabinet resonances and standing waves.

The action of a speaker is similar to a piston. Air entrapped in the enclosure is actually compressed and expanded as the speaker cone moves in and out. As this expansion and compression of air takes place, sound pressure is varied inside the cabinet.

This sound pressure is transmitted to the cabinet walls. When they are thin or unbraced, they act as diaphragms and transmit sound into the room. Cabinet radiation also causes dips and peaks in the speaker output and adds coloration to the sound.

Application inside the cabinet of damping materials with low sound-transmission properties minimizes the diaphragm action of the cabinet walls.

## Resonances and Standing Waves

There are two types of cabinet resonance that occur whenever a speaker is enclosed in a cabinet. They are fundamental resonance and spurious resonance.

Fundamental resonance is determined by the compliance of the cabinet, together with the compliance of the speaker. The bigger the volume the lower the fundamental resonant frequency for a given speaker.

Spurious resonances occur at frequencies whose wavelengths are a multiple or submultiple of the cabinet dimensions.

Whenever sound waves are generated within an enclosure they travel outward from the source (the loudspeaker cone), strike a wall, and are reflected. This reflected or "bouncing" wave action continues until the energy in the wave is dissipated and the wave dies out. The time it takes for this sound energy to be expended depends on the absorption properties of the reflecting walls.

Hard surfaces, such as wood, absorb little energy and are highly reflective. It takes a comparatively long time, therefore, for sound waves generated inside a wood cabinet to die out.

Sound waves built up inside a cabinet or enclosure in this manner are referred to as standing waves. If the

length of these standing waves is a multiple or sub-multiple of one of the cabinet dimensions, resonances occur.

It follows that the presence of standing waves causes a varying acoustical impedance or load to be presented to the speaker. When this happens peaks and dips in the speaker output result.

Many solutions have been offered to correct these conditions. The damping of cabinets or enclosures with an acoustical material has proved the most practical. Such a material should have two properties—high absorption, and low sound transmission.

Three materials recommended for their sound-absorbing properties were subjected to performance tests. Their relative sound-absorption and sound-transmission performances are compared in this report. The materials tested were:

1. Audiofelt, wool felt, 3/8-inch thickness (non-woven)
2. Fibrous glass 1-inch thickness (non-woven batt)
3. Cellulose fiber 2 1/2-inch thickness (asphalt-impregnated sheet)

The equipment used for the tests consisted of:

- Bozak 207-A speaker system
- Langevin 128-A 20-watt amplifier
- Magneorder Model PT6-BA2HZ tape recorder
- Capps condenser microphones, Model CM-2030C
- RCA wideband oscilloscope, Model WO-78A
- General Radio Model 1302-A audio oscillator

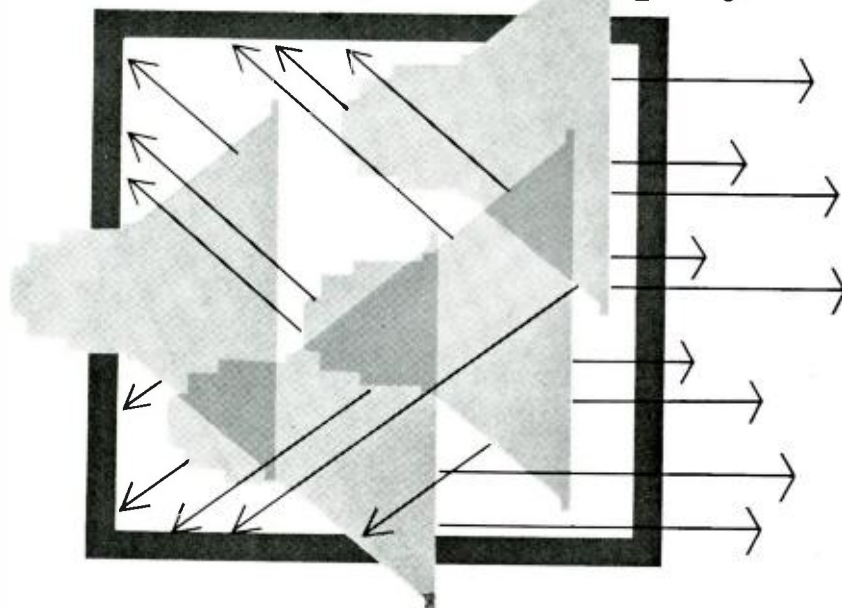
## Test Procedure

For all the tests the same amplifier and speaker were used. The speaker cabinet was approximately 11 cubic feet. The tests were made with the cellulose, fibrous glass, and felt materials in that order. Constant input power was maintained to the speaker for all the tests.

*Sound Absorption Tests:* These tests

\* 339 Twin Lane So., Wantagh, N.Y.

Improve speaker performance



# Hi-Fi Felt

*Laboratory tests conclusively prove FELT is the most effective damping material for hi-fi speaker enclosures!*

In recent tests made with the usual damping materials (fibrous glass and cellulose fiber), FELT was scientifically proven to be the only material really effective in the low-frequency range where troublesome cabinet resonances occur and where most of the power is transmitted.

The use of FELT resulted in a smoother power output over the entire frequency range from 50 to 15,000 cps, and acoustical power output from the speaker was increased from 25 to 50 per cent in the low- and middle-frequency range.

Listening tests prove without doubt, that sound from a cabinet lined with FELT has a cleaner sound with a much better balance between the highs and lows. "HI-FI FELT" only \$5.98 per sq. yd. (packaged)



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*"STUDIO QUALITY RECEPTION" for your Hi-Fi Room! Continental's new DECOR-FELT WALL COVERING — with the quiet dimension for distinctive interiors — eliminates unpleasant sounds — enhances tonal quality — turns acoustical problems into beautyspots. FREE color swatch folder on request!*



were made to determine which of the three materials had the best sound absorbing properties. The speaker cabinet was lined with each material. All the inside surfaces were covered with the exception of the front panel. A microphone was placed inside the speaker cabinet. This microphone was used to measure the sound pressures for selected frequencies between 50 and 15,000 cps. This is the range of frequencies encountered in hi-fi reproduction. Since damping materials are used to reduce the sound pressure inside the cabinet, their effectiveness is readily determined by measuring this sound pressure. The lower the sound pressure inside the cabinet the more effective the damping material.

**Sound Transmission Tests:** These tests were made to determine which of the three damping materials transmitted the least sound. This property is important in order to prevent the sound inside the cabinet from reaching the walls with sufficient amplitude to set them vibrating. Cabinet vibration is undesirable since it is out of phase with the front radiation from the speaker and can cause a power loss of as much as 50 per cent, which is especially noticeable at the low frequencies. The transmission tests were conducted by placing each material between the speaker and the microphone and recording the sound pressure drop in db. The tests were made at selected frequencies between 50 and 15,000 cps.

**Speaker Output Tests:** For this series of tests a second microphone was placed on the axis of the loudspeaker. This microphone measured the output of the speaker for selected frequencies between 50 and 15,000 cps. Since the same frequencies and same power input to the speaker were used for all three materials, it was easy to see the effect the different damping materials had on the speaker output. By examining the curves plotted from these tests it was possible to determine which damping material gave the smoothest output over the frequency range and which gave the highest power output. All sound pressures were measured in db. The data from these tests were plotted and are shown in the DATA section of this report. During the sound absorption tests, oscilloscope pictures were taken of the sound waves inside the cabinet. These pictures plainly show the differences between the three materials.

**Listening Tests:** As each material was tested, listening tests were made to determine the differences in sound caused by these materials. Various musical selections were played through the system and recorded on tape.

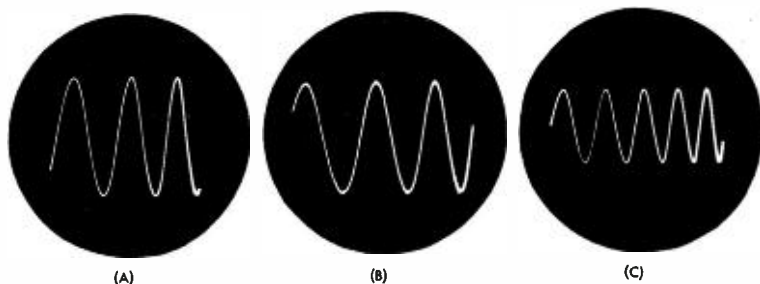


Fig. 1. Oscilloscope traces made during the Sound Absorption Tests. (A), cellulose material; (B), fibrous glass material; and (C), felt. The traces show sound pressures inside the speaker cabinet for a frequency of 50 cps.

#### Summary of Results

Figures 1 through 3 are photographs of oscilloscope traces made during the Sound Absorption tests. Figure 1 shows the sound pressures inside the speaker cabinet for a frequency of 50 cps, Fig. 2 the same data for 1000 cps, and Fig. 3 for 15,000 cps. In each case, (A) represents the cellulose material, (B) the

the three materials at various frequencies.

Figure 6 shows the results of the Speaker Output Tests. The output of the speaker, measured in decibels, is plotted vs. frequency for felt, and the three materials.

#### Discussion

A good damping material has two

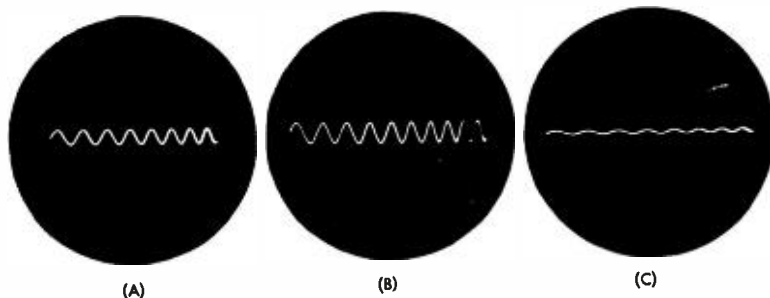


Fig. 2. Oscilloscope traces showing sound pressures inside the speaker cabinet at 1000 cps. (A), cellulose; (B), fibrous glass; and (C), felt.

fibrous glass material, and (C) the felt material.

Figure 4 shows the relative sound pressure in decibels vs. frequency for the three materials. The sound pressure was measured inside the cabinet and the curves plotted from data gathered during the Sound Absorption Tests. Figure 5 shows the results of the Sound Transmission Tests. The curves show the drop in sound pressure, in decibels, through

important properties—high absorption and low sound transmission. High absorption is necessary to prevent the reflection of sound inside the cabinet. Low sound transmission is necessary to prevent the undamped sound inside the cabinet from reaching the cabinet walls with sufficient amplitude to cause them to vibrate. If these two conditions are not met, standing waves result and spurious cabinet resonances occur. When

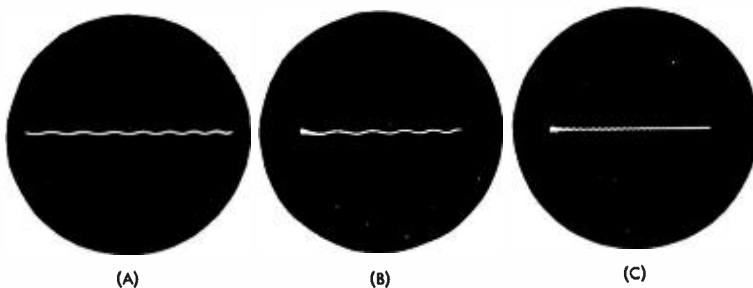
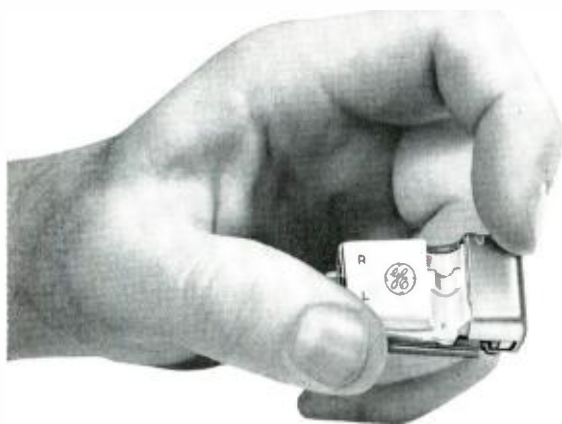


Fig. 3. Oscilloscope traces showing sound pressures inside the speaker cabinet at 15,000 cps. (A), cellulose; (B), fibrous glass; and (C), felt.

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VR-225 .5 mil diamond stylus. For professional-type tone arms, \$27.95.

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GENERAL  ELECTRIC

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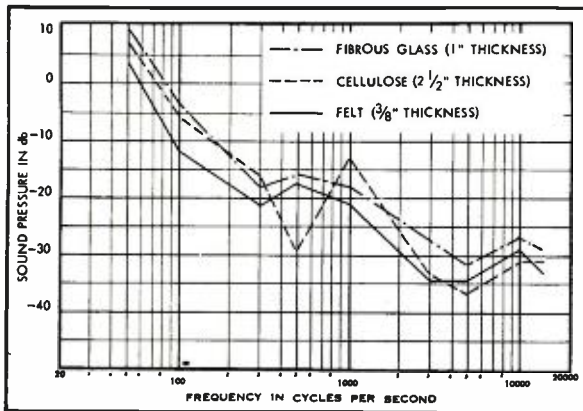


Fig. 4. Curves of relative sound pressure vs. frequency as measured inside the speaker cabinet.

this happens a general lack of clarity in the sound results, and the power output of the speaker is lowered.

An examination of Figs. 1 through 6 shows the superiority of felt over cellulose and fibrous glass in absorbing properties. Felt is particularly effective in the low frequencies. Referring to Fig.

tain most of the power and any loss in this range is very noticeable. Furthermore, most of the trouble from cabinet resonances occurs in this range.

On an average, felt was found to be 50 per cent more effective in damping throughout the entire frequency range from 50 to 15,000 cps.

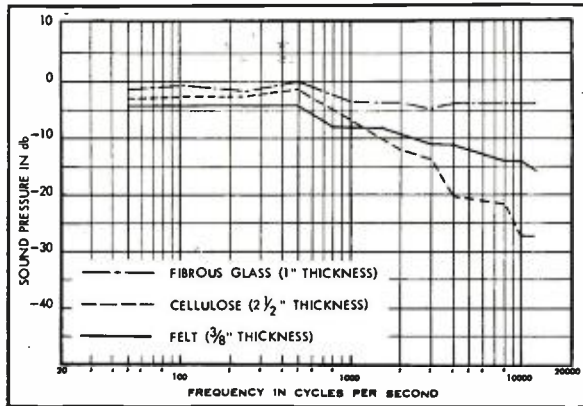


Fig. 5. Curves of drop in sound pressure through the three damping materials.

4, we see that in the low frequency range from 50 to 300 cps, the sound pressure inside the cabinet lined with felt was 3 to 6 db lower than for the other materials. This means that felt was 50 to 75 per cent more effective in damping the low frequencies. This is an important point, for the low frequencies con-

It should be pointed out that a thickness of only  $\frac{3}{8}$  in. was used for felt against  $2\frac{1}{2}$  in. for the cellulose and 1 in. for the fibrous glass materials.

During the transmission tests a double thickness of felt was also tried. It was found that the transmission loss was doubled, making it far more effec-

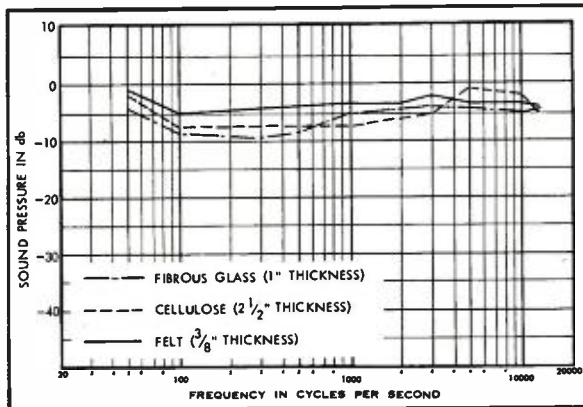


Fig. 6. Curves showing relative acoustic output from the three enclosures.

tive over the entire range than either of the other materials.

An examination of Fig. 5 shows the sound loss through the three materials. Fibrous glass was wholly ineffective, having practically no transmission loss below 500 cps, and only 3 db at the higher frequencies. This meant that any undamped sound inside the cabinet would be transmitted to the cabinet walls.

The cellulose material was effective above 500 cps, but this is not as important as it would seem. If we refer again to Fig. 4, we see that due to the high absorption of all the materials at the higher frequencies there is very little sound pressure inside the cabinet. Therefore, the real need is for low transmission and high absorption in the low-frequency range. Felt is 50 to 75 per cent more effective in this range than either of the other two materials.

The results from these tests would indicate that the use of felt should accomplish two things with regard to the sound output from the speaker: (1), the speaker output in the low and middle frequencies should be higher, and (2), speaker output should be smoother. This is actually what happened as an examination of the curves of Fig. 6 will show. These curves were plotted for specific frequencies, 50, 100, 300, 500, 1000, 3000, 5000, 10,000, and 15,000 cps.

The acoustical power output of the speaker was smoother and was 25 to 50 per cent greater with the use of felt. The fact that the use of felt causes the response to be smoother is very important, particularly in the high-frequency range. A lack of smoothness in this range causes the sound to have a very unpleasant "edge" or "sharpness."

## Conclusion

Felt was found to be a superior damping material. The possibilities for further development work that would lead to an ideal damping material are very exciting.

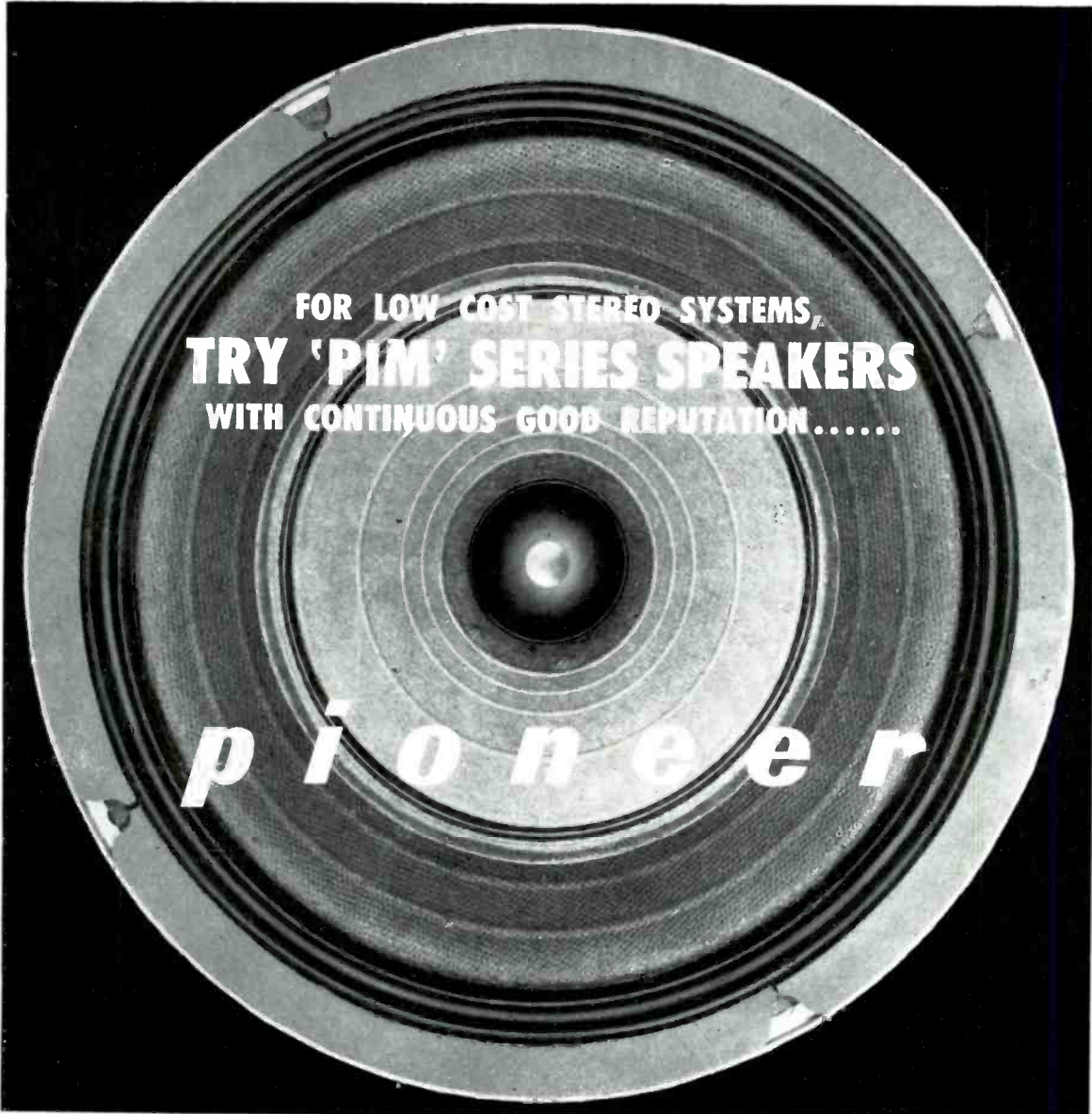
Felt was the only material really effective in the low-frequency range where troublesome cabinet resonances occur and where most of the power is transmitted.

The use of felt resulted in a smoother power output over the entire frequency range from 50 to 15,000 cps, and the acoustical power output from the speaker was increased from 25 to 50 per cent in the low- and middle-frequency range.

Listening tests confirmed the results of the above. The sound from the cabinet lined with felt was a cleaner sound with a much better balance between the highs and lows.

E





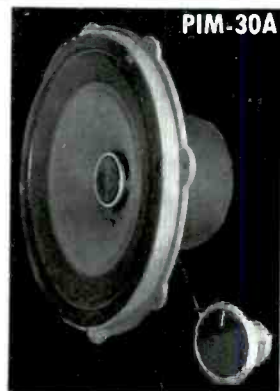
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Due to the mechanical filters furnished on the large outer cone, the directional characteristic is improved vastly in compared with the double-cone speakers made hitherto and intermodulation distortion is thus minimized and therefore, smooth overall response is provided at low cost.



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# The Tape Guide

## What to Look for in a Tape Recorder

HERMAN BURSTEIN\*

THE PRECEDING THREE ARTICLES have dealt with some basic matters that the audiofan will wish to consider in purchasing a tape machine: whether to buy a transport only or a transport and electronics; how many heads the machine should have; what kind of record level indicator is suitable for his purposes. The present article deals with additional factors, of varying degrees of importance, that play a part in a purchase decision. Some of these concern electrical performance, some mechanical perform-

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

Fig. 2. A stereo tape machine utilizing a plug-in attachment for recording second channel. (Tandberg) Unit of the left is the auxiliary recording amplifier for the second channel; without it, the machine plays stereophonically and records monophonically.



Fig. 1. A tape machine with provision for stereo playback and monophonic recording. (Norelco)

ance, and others operating convenience.

Probably no one machine contains all the features that may be desired by all audiofans. On the other hand, needs vary from one tape recordist to another. Through a preliminary familiarity with the features available in one machine or another, the audiofan is in a position to choose that tape recorder which is most likely to satisfy both his wants and his budget.

### Stereo Versus Mono

In view of the pace of stereo, the individual who purchases a tape machine for serious music listening is well advised to consider one equipped for stereo at least in the playback mode. Of course it is possible to modify a monophonic ma-

chine by replacing the mono playback head with a stereo head, but this calls for an additional playback amplifier, raising two problems: (1) that of closely matched equalization and amplification facilities in the playback amplifier for each channel; (2) that of a cable run to the additional amplifier, with high frequency losses taking place if the cable is too long, and with the possibility of hum pickup if the cable is improperly routed.

A number of tape machines now provide for stereo playback but only mono record, as illustrated in Fig. 1. If the audiofan has any thoughts of eventually wanting to record stereophonically, he should inquire whether such a machine has facilities for properly adding a record amplifier. The second channel re-



# AMPEX 960

STEREOPHONIC

RECORDER/REPRODUCER



RECORDS STEREO  
OR MONOPHONIC

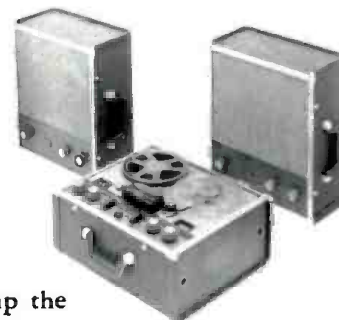
## Stereo Portable PLUS!

Guiding the Ampex engineers who created the 960 was a dual objective—that of building a machine which was not only a superb example of engineering skill, but one which would also offer its user a range of capabilities far exceeding that of any other recorder made today. The result was not merely an improved stereo recorder, but *an entirely new concept* in home entertainment.

The STEREO 960 fits into family life in literally dozens of ways, contributing many tangible benefits in musical, educational and recreational fun. You'll use it to keep up the family correspondence by sending "letters in sound", to tape stereo programs off the air, to preserve your best monaural and stereo discs on tape, and to acquire new musical and language skills. You'll have endless fun exploring the 960's many fascinating recording capabilities, including sound-on-sound, echo chamber effects, and other advanced techniques.

ABOVE--960 PORTABLE STEREO  
RECORDER/REPRODUCER

BELOW--MODEL 2560 PORTABLE  
STEREO SYSTEM CONSISTING OF  
960 AND PAIR OF 2010  
AMPLIFIER-SPEAKERS



AMPEX STEREO

SIGNATURE OF PERFECTION IN SOUND



# RECORDER/REPRODUCER SPECIFICATIONS

The true values of a recorder are best assessed through careful evaluation of its performance specifications and operating features. It is worthwhile noting here that these specifications are based not on theoretical design parameters but on actual performance tests. They are specifications which the recorder not only meets or exceeds today, but which years from now will still hold true. The Ampex Model 960 Stereophonic Recorder/Reproducer is capable of essentially distortionless frequency response from 30 to 20,000 cycles per second at the operating speed of 7½ inches per second, and from 30 to 15,000 cycles per second at 3¾ inches per second. Its precision-engineered timing accuracy is such that it offers perfection of pitch held to tolerances of less than one-third of a half-tone. Playing times, using standard (.002"), long play (.0015"), and extra-long play (.001") tapes are as follows:

	(a) 4-Track Stereo Tapes	(b) 2-Track Stereo Tapes	(c) Monaural Tapes, half-track
1200 foot reel	3¾ ips - 2 hrs. 8 min. 7½ ips - 1 hr 4 min.	3¾ ips - 1 hr. 4 min. 7½ ips - 32 minutes	3¾ ips - 2 hrs. 8 min. 7½ ips - 1 hr 4 min.
1800 foot reel	3¾ ips - 3 hrs. 12 min. 7½ ips - 1 hr 36 min.	3¾ ips - 1 hr. 36 min. 7½ ips - 48 minutes	3¾ ips - 3 hrs. 12 min. 7½ ips - 1 hr 36 min.
2400 foot reel	3¾ ips - 4 hrs. 16 min. 7½ ips - 2 hrs. 8 min.	3¾ ips - 2 hrs. 8 min. 7½ ips - 1 hr. 4 min.	3¾ ips - 4 hrs. 16 min. 7½ ips - 2 hrs. 8 min.

**RECORD INPUTS:** High impedance line inputs (radio/TV/phono/auxiliary) 0.3V rms for program level; high impedance microphone inputs

**PLAYBACK OUTPUTS:** Approximately 0.5V rms from cathode follower when playing program level tapes

**PLAYBACK FREQUENCY RESPONSE:** 30-20,000 cps at 7½ ips; 30-15,000 cps at 3¾ ips  
Within ±2 db 50-15,000 cps at 7½ ips, 55 db dynamic range  
Within ±2 db 50-10,000 cps at 3¾ ips, 50 db dynamic range

**FLUTTER AND WOW:** Under 0.2% rms at 7½ ips; under 0.25% rms at 3¾ ips

**HEADS:** Manufactured to the same standards of precision that exist in Ampex broadcast and recording studio equipment. Surfaces are lapped to an optical flatness so precise that they reflect specified wavelengths of light, resulting in uniform performance characteristics and greatly minimizing the effects of head wear. Azimuth alignment of stereo head gaps in the same stack is held within 20 seconds of arc, equivalent to less than 10 millionths of an inch—a degree of precision achieved through use of a unique process involving micro-accurate optical measurements within a controlled environment. Head gap width is 90 millionths of an inch ±5 millionths of an inch.

## KEY TO THE EXCITING FUN FEATURES OF THE 960— THE AMPEX STEREO-GRAPH

Here's the simplest, quickest answer to almost every question about how to perform the operations illustrated at right and numerous other recording functions. The Ampex Stereo-Graph shows you, quickly and clearly, the proper dial settings to make for more than a dozen of the most popular uses for the 960 . . . including sound-on-sound, language and music instruction,



and other special effects. A convenient tape footage/playing time indicator is included on the reverse side.

## MODEL 2010 MATCHING AMPLIFIER-SPEAKER

The Ampex Model 2010's ten-watt (20 watts peak) amplifier section provides operating characteristics (unequalized) flat within ±0.1 db, with total harmonic distortion less than 0.5 of 1%, throughout the maximum range of human hearing ability, at rated output. Noise and hum are 80 db below rated output, and input sensitivity is 0.18V to develop rated power.

The specially designed 8" speaker provides smooth, peak-free response throughout a remarkably wide audio range. Such superior design features as its massive die-cast frame and edgewise-wound ribbon coil contribute effectively to higher levels of performance than ever before achieved with a speaker this size.



MODEL 960 DIMENSIONS: Portable cases 9" x 15" x 17½". Unmounted recorder 13" x 15" x 6½" depth below top plate, 1¾" above. Recorder weight 36 lbs., speaker amplifier 31 lbs.

AMPEX AUDIO, INC. • SUNNYVALE, CALIFORNIA AANS

Relax and enjoy the show—let your Ampex do the narration! With the commentary on tape, your color slide shows are more professional, more complete, and more fun!

Your favorite LP's and Stereo Discs are at their exciting best while they're new and unscratched. That's when to tape them on your Ampex, and preserve their original quality for keeps!

When you tape it "off the air" your only cost is for blank tape. Yet your musical repertoire can soon equal that of all the stations you hear!

There's a real future in family fun like this—with your Ampex you can live such happy moments over and over again, with a quality so lifelike you're almost literally carried back.

In the Ampex "Speech Testing Game", you pit your wits against the trigger-quick memory of the Ampex recorder/reproducer. You can't win, but it's fun trying.

Letter-writing is no longer a problem, with an Ampex in the house . . . now it's a family project. And even more fun than sending letters in sound is receiving them!

For "letters in sound", the 3" tape reel holds as much as a 10-page letter, mails first class anywhere in the United States for 8c.

A command performance, exclusively for you! Whether you prefer jazz, pop, or classical, the privacy of headphone listening is a unique pleasure. You don't disturb the rest of the family, and they don't disturb you!

The Ampex, in private rehearsal, can be a wonderful confidence-builder for people who normally develop rubber knees when faced with the prospect of speaking before a group.

Learning to speak a new language is made immeasurably easier on the Ampex; you can record your own phrases side-by-side with those of the instructor, and play them back for comparison at any time.

When you strike up the band in stereo, you don't need professional musicians to make a professional recording. Advanced techniques are amazingly easy on the Ampex.

cord amplifier should have the same equalization and gain as for the other channel, and—very important—there should be means for synchronizing the bias oscillators in the two amplifiers, if separate oscillators are used, so that they will operate at the same frequency. Bias current in each channel will to some degree leak through to the other channel. If the two currents are of different frequency, they will beat together, and the resulting beat frequencies will appear on the tape, causing birdies and other objectionable sounds. *Figure 2* shows a tape recorder designed to permit addition of a second record amplifier; in this case the oscillator of the first channel also serves the second channel.

#### Tape Speeds

For home purposes, in the past few years the virtually standard speed compatible with high fidelity has been 7.5 ips, which permits frequency response to about 15,000 cps and at the same time allows satisfactorily low distortion and a satisfactorily high signal-to-noise ratio. The 3.75-ips speed has also been widely used, although not considered compatible with high fidelity. The principle difficulty at the lower speed lay in high-frequency response. All other things remaining equal, the frequency response of a tape machine varies directly with tape speed. Thus a machine capable of maintaining flat response to, say, 12,000 cps at 7.5 ips (response may be 3 to 6 db down at 15,000 cps) will be able to maintain flat response only to 6,000 cps at 3.75 ips.

The problem at 3.75 ips occurs in large part in playback, being due to the fact that treble response varies inversely with width of the playback head gap. The recent introduction of heads with extremely narrow gaps—as fine as .00009"—has made it possible to extend frequency response to about 15,000 cps at 3.75 ips *so far as playback is concerned*. But there are also very serious recording losses at high frequencies due to bias current and to the phenomenon known as self-demagnetization (recorded frequencies on the tape are equivalent to small bar magnets; the higher the frequency, the smaller is the equivalent magnet and the greater is the tendency of the opposite poles of each magnet to cancel each other).

By using somewhat less bias current than at 7.5 ips (which reduces treble losses), by recording at somewhat lower levels (which compensates for the greater distortion because of reduced bias), and by using somewhat more treble boost in recording, it has been found possible to put on the tape at 3.75 ips a signal with frequency response corresponding at least to minimum high fidelity standards and having acceptably low distortion and acceptably high signal

to noise ratio. This does not mean that 3.75-ips tapes are yet as good as 7.5-ips ones of recent vintage. However, they are already as good as the 7.5 ips tapes of several years ago, and it can be expected that technological progress will bring further improvement.

Accordingly, the serious audiofan may wish to include the 3.75-ips speed and to make sure that the machine he purchases does all that is possible in the present state of the art to achieve maximum performance at this speed. Specifically, he will want a machine with a playback head that has a gap of .0001" or less, and having the recording equalization and bias current that allow frequency response to extend to 10,000 cps and beyond. On the other hand, since equalization and bias current requirements will be different at the 7.5-ips speed, he will want to make sure that performance at this higher speed is not compromised by failure of the machine to change the bias and equalization when the tape speed is switched to 7.5 ips.

The audiofan will probably find that that 3.75-ips speed is quite suitable for various types of program material not of the highest fidelity, such as old records one wishes to copy (in fact, the loss of the higher frequencies can be a distinct blessing in this situation since these frequencies will consist more of noise than music), AM station programs, etc. Or there may be situations where one is willing to exchange some sacrifice in quality for the privilege of doubling the recording time on a reel tape. Thus in taping an opera or other lengthy work, one can get from two to four hours of time on a 7-inch reel, using half-track monophonic recording or quarter-track stereo recording. Regular tape will yield two hours, long-playing tape three hours, and extra-long-playing tape four hours.

For non-high-fidelity applications, such as recording speech, dance music for parties, and so forth, the 1.875-ips speed is coming into increasing use. In fact, this speed now enjoys about the same status as 3.75 ips formerly occupied. A number of tape machines now offer this speed along with a surprisingly satisfactory quality for non-critical uses where length of playing time is important. Thus on a 7-inch reel of tape one can record from four to eight hours of material at 1.875-ips, depending upon whether one is using regular, long-playing, or extra-long-playing tape.

#### Frequency Response

At 7.5 ips, a modern tape recorder should be able to cover the range of 40 to 15,000 cps, being no more than 3 or 4 db down at either extreme and achieving quite flat response—within  $\pm 1$  db or  $\pm 2$  db between 50 and 10,000 cps. Response within  $\pm 3$  db may be considered satisfactory, but not of top quality. At 3.75

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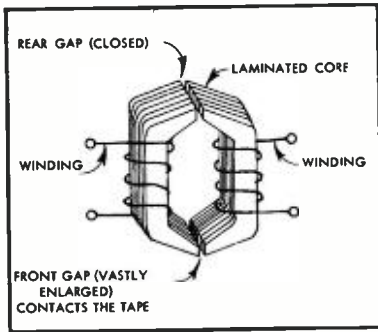


Fig. 3. Tape head of laminated construction.

ips, response should extend at least to 10,000 cps, remaining reasonably flat between 50 and 8000 cps. At 1.875 ips, response to about 5000 cps may be expected.

### Distortion and Signal to Noise Ratio

The playback amplifier is generally the dominant source of noise in a tape reproducing system. The amount of signal produced by the tape playback head is at the most a few millivolts in the audio mid-range and is a fraction of a millivolt at low frequencies. When this weak signal undergoes the necessary amplification and equalization (bass boost), the noise and hum of the first stage in the playback amplifier and the hum picked up by the head, are also greatly magnified. The more signal on the tape—that is, the higher the recording level—the greater is the magnitude of the audio signal relative to playback noise and hum. In other words, the signal to noise ratio is greater. Unfortunately, as the recording level is increased, there is also an increase in distortion due to the characteristics of the tape. In sum, then, distortion and signal-to-noise ratio go hand in hand; the more distortion one is willing to tolerate in a tape system, the higher is the feasible signal-to-noise ratio, assuming that all else remains the same.

It follows that one must define how much distortion is acceptable. However, this is not a straightforward problem. To begin with, tape distortion is almost invariably stated in terms of harmonic rather than intermodulation distortion, because the amount appears respectably low in terms of harmonic distortion but tends to assume outlandish proportions when stated as intermodulation distortion. Whether maximum harmonic distortion should be 1, 2, 3 per cent, or possibly more is a viewpoint that varies considerably among tape machine manufacturers.

Signal-to-noise ratio of the top quality machines tends to be rated by their manufacturers on the basis of 1 or 2 per cent maximum harmonic distortion. This may correspond roughly to about 5 to 10 per

cent IM. Many machines, however, state performance in terms of 3 per cent harmonic distortion, and some even in terms of 5 per cent; these amounts may correspond to 30 per cent and more IM. Considering that the difference between recording at a level that results in 1 per cent harmonic distortion and recording at a level productive of 5 per cent harmonic distortion represents an increase of about 8 db in recording level, it can be understood why some manufacturers rate their machines on the basis of 5 per cent. They are adding 8 db to the signal-to-noise ratio they can claim for their units.

The audiofan desiring truly clean, silky recordings—assuming such program material is available to him—will probably not want to operate his machine at levels that take him into 5 per cent harmonic distortion. More likely, he will want to stop at about the 1 or 2 per cent level. Therefore, a tape recorder should be rated for signal-to-noise ratio in terms of a signal, in the range of 250

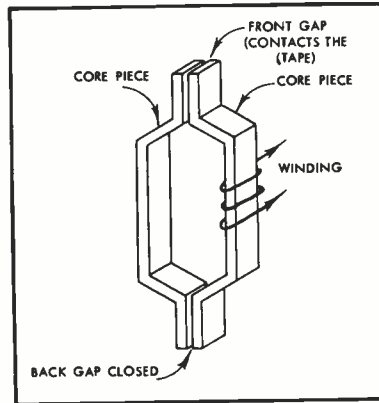


Fig. 4. Tape head of non-laminated construction.

to 500 cps, recorded at a level producing no more than 1 or 2 per cent harmonic distortion. If the ratio is based on a higher distortion figure, one can make a rough adjustment by subtracting 2 db for each 1 per cent of distortion above 1 per cent level.

Based on 2 per cent harmonic distortion, which is the NARTB (now NAB) standard, a tape recorder may be considered excellent if it achieves a signal-to-noise ratio of about 55 db, and very good if the ratio is closer to 50 db. Below 50 db begins to get out of the category of high fidelity. Less than 45 db tends to be unsatisfactory. With a machine having a signal-to-noise ratio that approaches 55 db, one can make a clean recording and play it back at life-like levels, yet have virtually no discernible background noise during quiet passages. Such machines, unfortunately, are still much more the exception than the rule so far as home tape recorders are concerned. On the other hand, there are a

few, some at relatively moderate prices, that are the equivalent of professional machines in this respect.

### Quality of Heads

Audifans are wont to be very discriminating about the phono cartridges they choose for their audio systems. In similar fashion, there are quality differences among tape heads that deserve attention. Some of the factors involved in head quality are as follows:

1. *Gap Width.* As pointed out before, the narrower the gap, the better the high-frequency response in playback. Most playback heads encountered today have gaps sufficiently narrow to permit relatively flat response throughout the audio range at 7.5 ips and a close approximation to such response at 3.75 ips. The gap should be .00025" or smaller for speeds of 7.5 ips or higher. It should be .0001" or smaller for 3.75 ips.

2. *Gap Linearity.* Recording of the tape takes place at the trailing edge of the record head gap (the last edge contacted by the moving tape). To achieve a well-defined signal on the tape, it is necessary that this gap edge be equally well defined. It must be as perfectly sharp and straight as possible. Sharpness of the gap edge—in this case both edges—is also vital in playback. If the edges are rounded, then the gap magnetically behaves as though its physical width were increased. Thus a head with a .00025" gap and very linear edges may provide better high-frequency response than a .00015" head with a less well-defined gap. In a high-quality playback head, the magnetic gap is about 10 per cent wider than the physical gap.

3. *Head Construction.* Heads are basically of two types, laminated and non-laminated, as illustrated in Figs. 3 and 4. The laminated head tends to have greater output because of its greater volume of magnetic material. Moreover, the laminations serve to reduce eddy current losses (by interrupting eddy current flow), which increase with frequency.

Figure 5 shows another type of non-laminated head, whose gap has considerably less depth than in Figs. 3 and 4. This means that the gap wears more

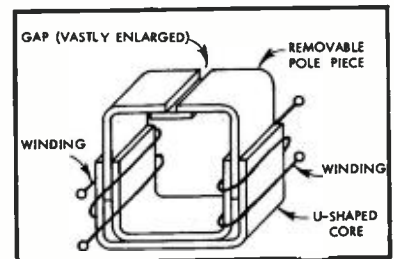


Fig. 5. Another type of non-laminated tape head.



quickly, with attendant loss of high-frequency response.

4. *Hum-Bucking Windings.* Whereas the heads in Figs. 3 and 5 each have two sets of windings, the head in Fig. 4 has only one winding. Two windings are desirable because this permits connecting them in series so as to balance out hum and at the same time increase voltage output. The manner of connection is illustrated in Fig. 6. Hum polarity tends to be the same at each output terminal, so that there is little or no hum potential between the terminals. On the other hand, the signal polarity at one terminal is positive when the other is negative.

5. *Saturation.* The core and design of the record head must be such as to permit sufficient magnetic flux to be developed to magnetize the tape, but without saturating the head and thereby causing distortion. While tape heads are generally satisfactory in this respect, the writer has come across instances where the record head saturated before the tape did.

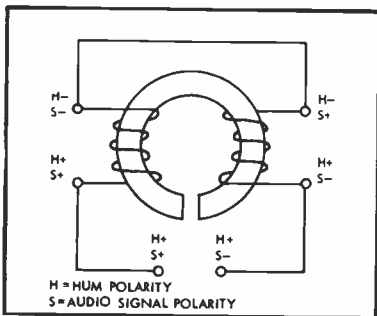


Fig. 6. Connecting the dual windings of a tape head in series for maximum voltage output and for hum cancellation.

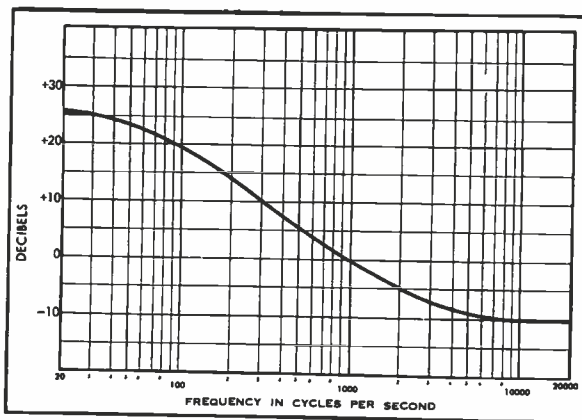
#### Wow and Flutter

Wow refers to slow variations in speed, below ten times per second, heard as a quavering or "sourness" in the frequency being reproduced. Flutter refers to rapid variations in speed, up to thousands of times per second, which tend to be heard as extraneous sounds in the nature of noise. That is, one hears a frequency corresponding to the rate of fluctuation.

Professional performance calls for wow and flutter not to exceed 0.2 per cent, and preferably to be less than 0.1 per cent. This is not very easy to achieve, particularly when tape speed is below 15 ips. One may say, then, that for home purposes, about 0.25 per cent is the maximum amount consistent with high-fidelity performance.

The ear is a good instrument for checking wow and flutter. By playing a test tape having a recorded frequency of about 3000 cycles (or by making such a tape with the aid of an audio oscillator), one can readily determine whether wow and flutter are unduly offensive. Wow

Fig. 7. NARTB playback Equalization.



will be apparent as an unsteadiness in the sound. Flutter will be noticeable as imparting a grainy or noisy quality to the note.

#### Speed Accuracy

Professional requirements are that tape speed be correct within  $\pm 0.3$  per cent. Since there are 1800 seconds in one half-hour (approximately the playing time for one track on a 7-inch reel of standard tape), a 0.3 per cent error translates into 5.4 seconds slow or fast per half hour. Professional machines, and sometimes the semi-professional ones as well, generally achieve an accuracy of 0.2 per cent, which is 3.6 seconds slow or fast per half-hour.

So long as a tape machine is employed to play only tapes recorded on the same machine, the speed error is of no consequence, assuming the error remains the same over time. However, if commercially recorded tapes or other tapes made on different machines are to be played, speed errors appreciably greater than 0.3 per cent, particularly those over 1 per cent, are apt to be noticed as significant deviations from correct pitch.

The better tape machines employ synchronous motors, whose speed is essentially determined by the line frequency, namely 60 cps. But use of a synchronous motor for driving the capstan does not in itself guarantee accurate speed. The

diameter of the capstan may be out of tolerance, resulting in excessive speed error. Or there may be other misadjustments.

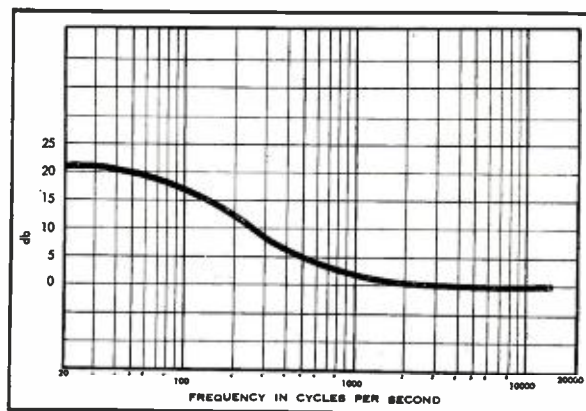
The individual who pays the extra cost of a tape machine containing a synchronous motor is entitled to a speed accuracy within 0.3 per cent. Should he find, through a test timing tape or use of a tape stroboscope, that the error exceeds 0.3 per cent, he is entitled to have this excessive deviation corrected by whatever means are appropriate, including replacement of the machine.

On the other hand, if the machine does not have a synchronous motor, speed errors up to 1 per cent should be expected and tolerated. Over 1 per cent may be considered excessive for a high-quality home machine with a non-synchronous motor.

In measuring speed accuracy, this should be done at several portions of the reel, because the error will tend to vary from beginning to end of a reel of tape.

While it is desirable for the individual to measure speed accuracy (by means of a stroboscope or test tape), in the great majority of instances there is nothing he personally can do to correct the situation. Whereas a fair number of phono turntables and even record changers provide the operator with means for readily adjusting speed, it is a rare tape recorder that makes such provision. Before

Fig. 8. Playback equalization employed at 3.75 ips.



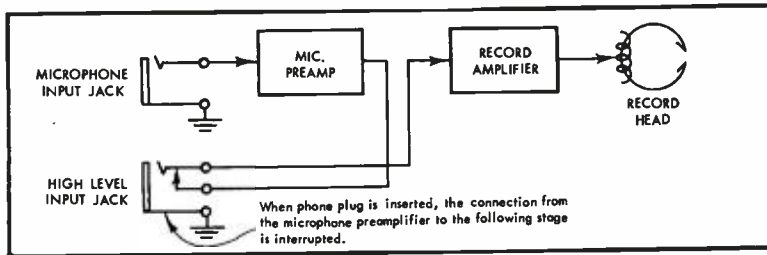


Fig. 9. Tape machine permitting one to record from a microphone or a high-level source, but not both at once.

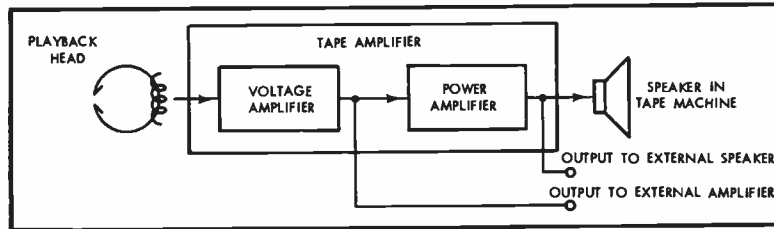


Fig. 10. Tape machine with separate outputs for external speaker and external amplifier.

the user seeks to tinker with the transport mechanism in order to speed it up or slow it down, he should take into consideration that this attempt is likely to backfire. He may improve speed accuracy, but at the same time he may cause an increase in wow and flutter, which are generally more deleterious to satisfactory musical reproduction than are moderate speed errors. The user's best recourse is to take a seriously inaccurate machine back to the point of purchase.

### Equalization

NARTB equalization (Fig. 7), or a close approximation thereto, is considered virtually standard today for tape recorders operating at 7.5 ips. Accordingly, the tape recorder should provide NARTB playback equalization within  $\pm 2$  db at 7.5 ips. Otherwise, when playing commercial recorded tapes, frequency response may depart significantly from flat. Inasmuch as most machines that depart from the NARTB playback characteristic provide inadequate bass boost, the resultant response when playing a recorded tape will be a thin bass sound. These machines sometimes apply considerable treble boost in playback, whereas none is called for by NARTB (except to compensate for head deficiencies), so that shrillness is introduced when playing a recorded tape.

With respect to the 3.75-ips speed, the equalization question is not settled at the present writing. For a time, equalization such as in Fig. 8 was employed. Recently, however, there has been a trend toward employing NARTB equalization (Fig. 7) for 3.75 ips as well as for 7.5 and 15 ips.

Assuming that NARTB playback equalization is employed at both 7.5 ips and 3.75 ips, nevertheless, different record equalization will be required at

each speed because the recording losses vary with tape speed. Therefore the tape recorder should contain switching facilities to vary the record equalization with speed. Some machines, however, employ the same record equalization at both speeds. The result is that frequency response—in terms of smoothness as well as range—is not as good at either speed as it might be, because compromise equalization is used; or else the result is that, if good frequency response is maintained at 7.5 ips, then response is considerably short of as good as it might be at 3.75 ips because the other speed has been favored.

### Inputs

Tape recorders customarily have two inputs. One is for high-level sources, such as the signal from a tape output jack of a control amplifier, or the signal

obtained directly from a tuner, TV, or the like. The other input is for microphone. In many cases these are alternative inputs, as illustrated in Fig. 9, so that one can record from one input or from the other, but not from both at once. Insertion of a phone plug into the high-level input jack disconnects the microphone signal. In other instances, it is possible to record from both sources simultaneously. Too often, however, only the high-level input has a gain control, so that it is difficult to achieve satisfactory mixing. In the better machines, there are individual gain controls for each input.

The microphone input in the lower-price machines is customarily intended for a piezoelectric (ceramic or crystal) microphone or for a high-impedance magnetic microphone. If one intends to use a crystal or ceramic microphone, it is necessary to ascertain that the input impedance of the tape recorder is sufficiently high to permit full bass response. Typically, an input impedance of 5 megohms or more is required; this depends upon the particular microphone used. Information on the necessary input impedance should be obtained from the microphone manufacturer. If the input impedance of one's tape recorder is less, the necessary modification should be made by a service technician.

A high-quality tape recorder (usually the semi-professional and professional ones) will provide an input for a low-impedance microphone, which permits a long run of cable to the tape recorder without loss of high frequencies and which is less sensitive to hum pickup than the high impedance type.

### Outputs

Although a tape machine may contain its own power amplifier and speaker, it should still provide an output jack for

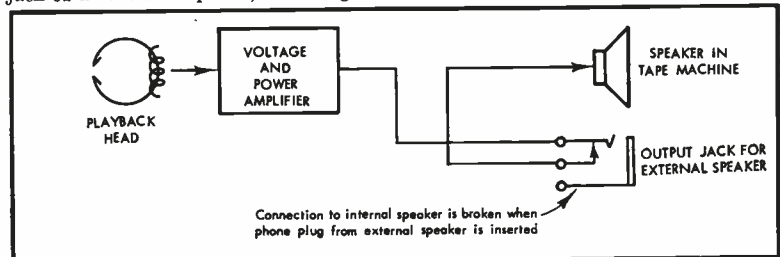


Fig. 11. Means for automatically disconnecting a tape machine's internal speaker when an external speaker is plugged in.

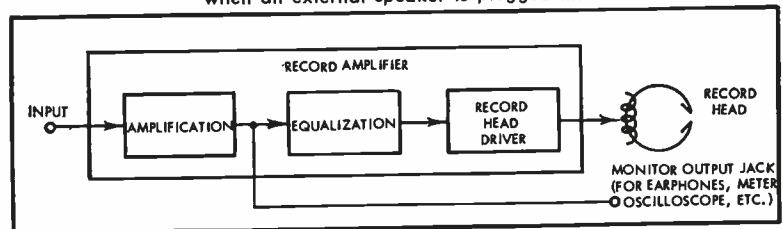


Fig. 12. Tape machine with a monitor output jack.

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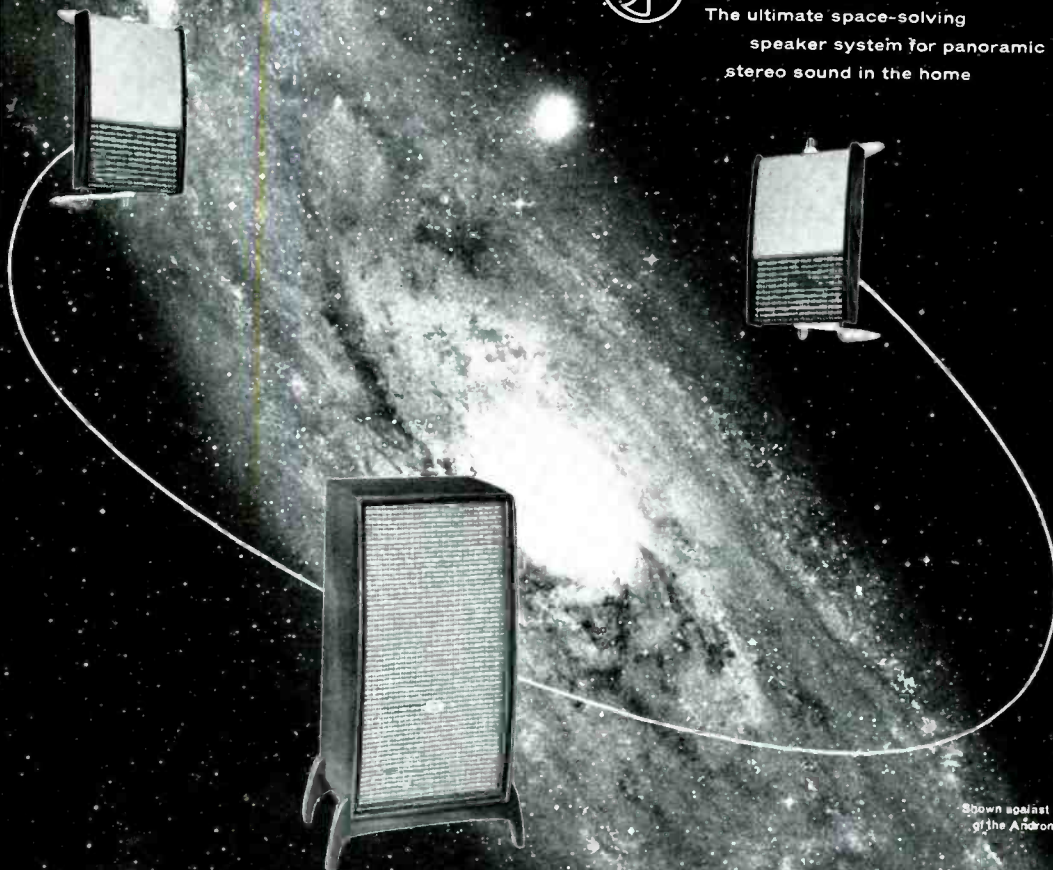
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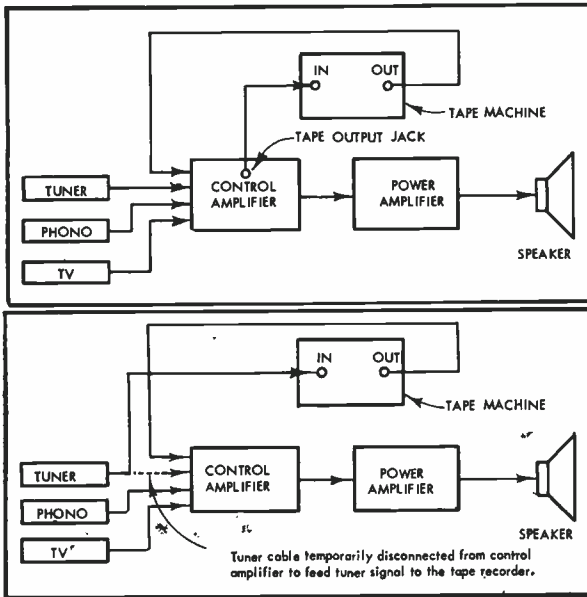


Fig. 13. Most frequently used method of feeding signals from a high fidelity system to a tape machine.

Fig. 14. Seldom-used method of feeding a signal from a high-fidelity system to a tape machine.

feeding an external audio system. Preferably, for minimum distortion, the signal should be taken from a point prior to the power amplifier of the machine. In some units, however, there is an output jack designated for feeding either an external speaker or an external amplifier; in this case the signal is taken after the internal power amplifier. The better situation is where there are two output jacks, one for feeding an external amplifier and the other for feeding an external speaker, as illustrated in Fig. 10.

To obtain as flat response as possible, it is ordinarily desirable that the signal at the output jack be taken from a point prior to the machine's tone controls, if any. In some machines, however, the tone controls are employed as part of the equalization circuit, and in this case one would want the playback signal after the tone controls. At the same time, it is necessary to ascertain the position of these controls that achieves flat response.

If the tape machine contains its own power amplifier and speaker, means should be provided for cutting off the internal speaker when the signal is fed to an external sound system. In some cases this is done automatically when a plug is inserted into the output jack, as shown in Fig. 11.

Some tape recorders contain a monitor jack, so that when recording one can listen to the incoming signal with earphones, as shown in Fig. 12. While this gives some evidence that the recording signal is getting through, it is not positive proof that the signal is being satisfactorily recorded. Such proof is obtained only by using a machine with separate record and playback heads, which permits the signal being recorded to be played back immediately and checked. However, a monitoring jack does have worthy uses. Thus if one is re-

recording directly from a tuner or phonograph, one can at least check the quality of the incoming signal. Or one could attach an oscilloscope or meter (high impedance, to avoid loading effects) to evaluate the nature of the signal with respect to amplitude, transients, frequency response, and so on.

To permit a long cable run from the tape machine to the following equipment without high-frequency loss, a low output impedance is desirable. It is for this reason that the output jack in some machines is connected after rather than before the power amplifier stage (we are speaking, of course, of those units having their own power amplifier and speaker). A preferable course is for the machine to incorporate a cathode fol-

lower or other low-impedance circuit (such as a plate follower) in the output stage.

### Input Sensitivity

When recording from a source other than a microphone—FM tuner, AM tuner, TV sound, phono pickup—most audiophiles will obtain the signal from a control amplifier, as illustrated in Fig. 13, rather than by feeding the source directly into the tape recorder, as shown in Fig. 14 (where the source is a tuner). In a number of control amplifiers, the incoming signal is routed directly to the tape output jack (for feeding a tape recorder), without amplification or attenuation of the signal, as illustrated in Fig. 15. Since high-level sources generally produce at least 0.5 volts on peaks, it would appear that a tape recorder sensitivity—input signal required to drive the machine to full permissible recording level—of 0.5 volts is sufficient for high-level signals. However, it is advisable to allow for two contingencies: (1) the occasional high-level source that produces less than 0.5 volts; (2) the desirability of going above normal recording level, as for example on speech, where distortion is less apparent than on music. Accordingly, the high-level input sensitivity of a tape recorder should be about 0.1 to 0.2 volts.

In some control amplifiers, as illustrated in Fig. 16, the incoming signal first goes through an input level-set control. Then it goes through a stage of gain before reaching the tape output jack, at which point it may be restored to approximately its original level. However, there is no assurance that such

(Continued on page 95)

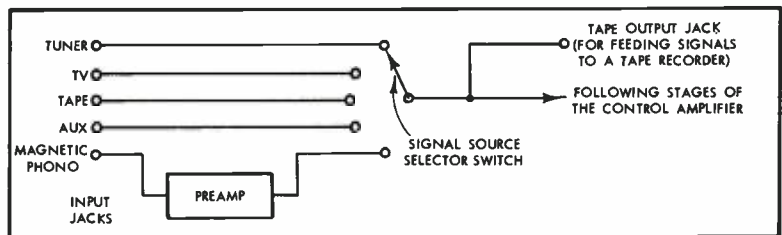


Fig. 15. Method employed in some control amplifiers for feeding incoming signals directly to a tape recorder.

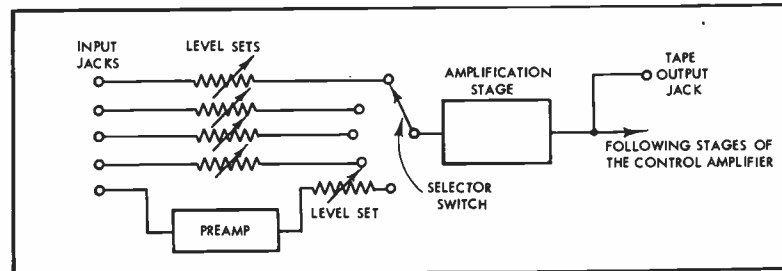
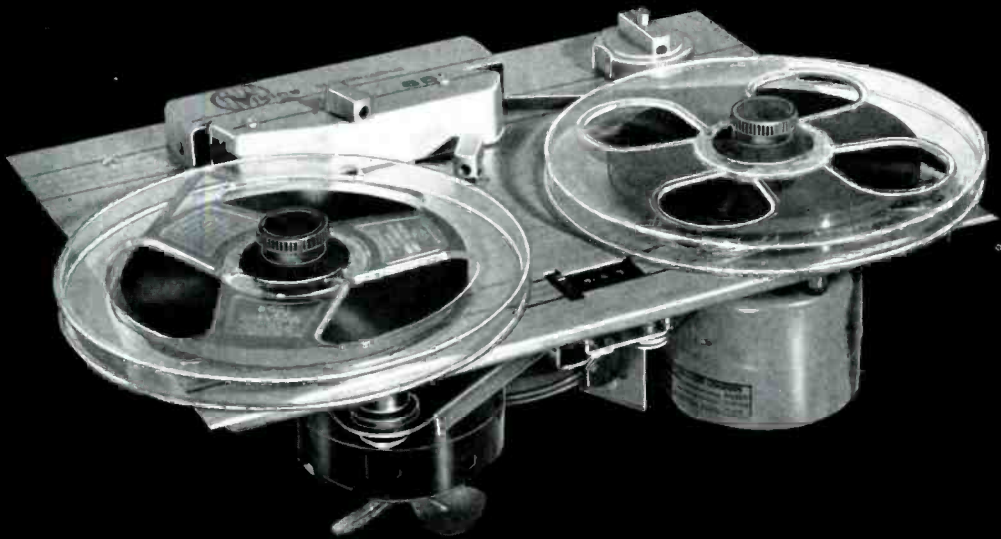


Fig. 16. Method employed in some control amplifiers for feeding incoming signals to a tape recorder.

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# Variable Electronic Crossover and Biampifier

GEORGE C. KANE\*

The author describes a combined variable electronic crossover and a biampifier that has a mid high-frequency power output of 20 watts and a low-frequency power output of 50 watts.

**M**ANY AUDIOFANS who build their own hi-fi equipment, and some who purchase kit-type components, soon realize that the cabinet space allotted to the system becomes too small. The author's system went through the usual series of speaker additions and associated L-C crossover networks. The frequency of crossover could not be varied so there was always a question as to whether the speaker performance could be improved with a change in crossover frequency.

Recently, a new component—a Variable Electronic Crossover—appeared on the market. The electronic crossover seemed to have some desirable features and some not so desirable. The good features are that it contains a method of changing the crossover frequency, reduces intermodulation distortion, absorbs no audio power, and does not affect speaker damping. Undesirable features are that it requires another amplifier (one for each channel), and if not

properly designed and constructed it can produce hum and noise. There are other pro's and con's that will not be taken up here.

There are two general types of electronic crossover units. One has a fixed crossover frequency, the other type contains a method of varying the crossover frequency. To the author, the type having a variable crossover seemed most desirable. The first model constructed contained a switch that was used to change capacitor values in the variable portion of a low-pass and a high-pass filter, resistor values remaining fixed. An old amplifier was brought out of retirement and the system placed in operation. The speakers seemed to take on a new brilliance not heard before. Results were excellent until the crossover frequency switch was changed to another crossover frequency—the thud that came from the speakers was powerful enough to toss the speaker cones into the middle of the living room! Another undesirable feature was pointed out by the little

wife—she didn't want a chassis (electronic crossover) to remain on top of a choice piece of furniture (no space in the cabinet), nor did she approve of an amplifier (additional amplifier for treble) on the floor behind a chair.

Since the original space for the amplifier could not be enlarged, consolidation of components was necessary if the electronic crossover was to be retained. After many hours at a drawing board and trying different arrangements of parts on various shapes of chassis, the combined electronic crossover and biampifier shown in Fig. 1 was constructed. The complete schematic is shown in Fig. 2.

## Electronic Crossover Section

A block diagram of the variable electronic crossover portion of the biampifier is shown in Fig. 3. The output of a preamplifier feeds two level controls, one for the high-frequency channel (for the purpose of this article, the high-frequency channel is called the *treble* channel although it may contain frequencies below several hundred cps), and one for the low-frequency, or bass, channel. Each channel is then coupled to a voltage amplifier where the program material is amplified and passed on to a cathode follower. So far, both channels are the same with the exception of the coupling capacitors ( $C_1$ ,  $C_2$ ,  $C_{15}$ , and  $C_{16}$  in Fig. 2), but here the similarity ends. Negative feedback is provided through resistors  $R_5$  and  $R_{39}$  to improve frequency response and to reduce stage gain to about four.

Cathode follower  $V_{1B}$  feeds a high pass filter, (B) in Fig. 4, consisting of two R-C sections. The impedance ratio of the first section to the second section is 1 to 4. Therefore the slope of the curve is approximately 8 db per octave. Cathode follower  $V_{1B}$  feeds a low pass filter, (A) in Fig. 4, which attenuates high frequencies at the same 8-db-per-octave rate. The filters present curves that are inversely symmetrical, (C) in Fig. 4. When gain controls  $R_1$  and  $R_{35}$  are ad-

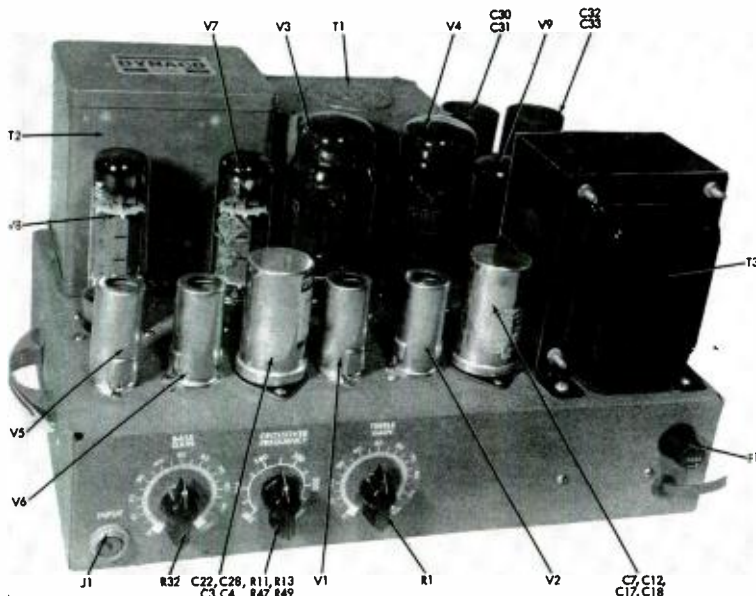
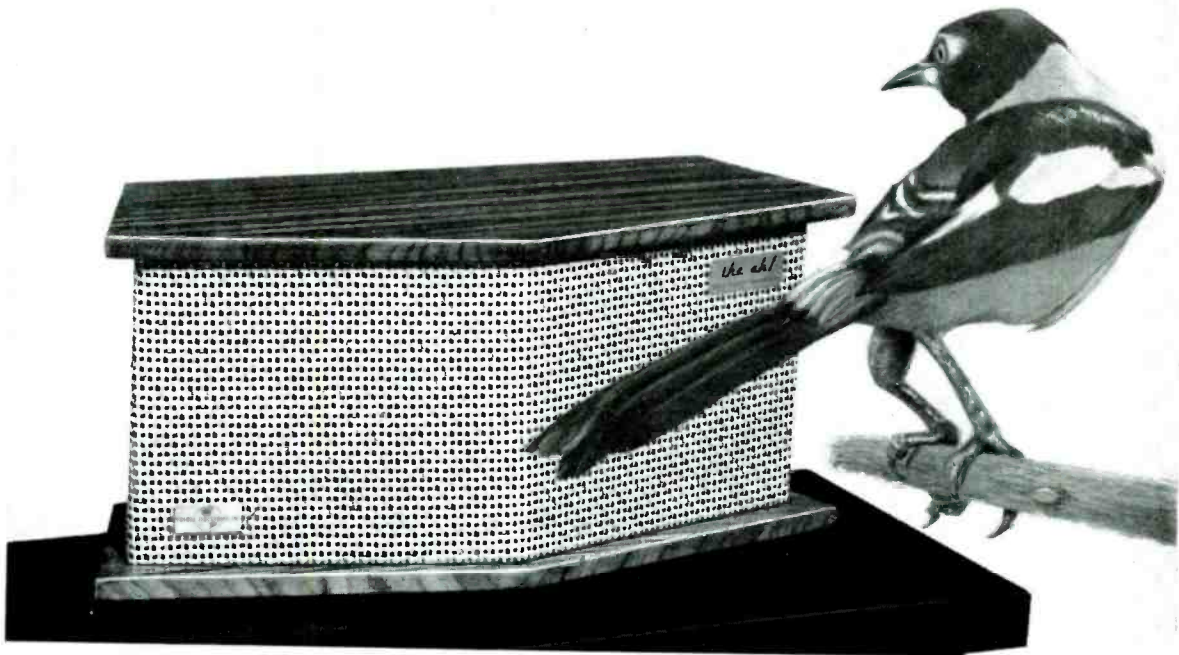


Fig. 1. The author's biampifier, showing placement of major parts.



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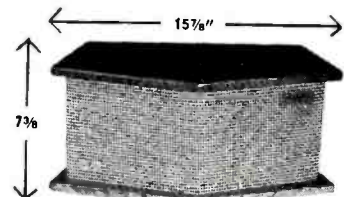
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justed so that the flat portions of the curves are at the same level, the point where each curve is down 3 db (half-power point) is the crossover frequency. At the 3-db point, each filter is delivering half power and the two filters together deliver full power resulting in an overall curve that is flat.

The crossover frequency is changed by varying the crossover control which has four variable resistances ( $R_{11}$ ,  $R_{13}$ ,  $R_{17}$ , and  $R_{19}$ ) combined into one control. When the control is in the counter-clockwise position (resistances at maximum) the filters are adjusted to a crossover frequency of 100 cps. The full

clockwise position of the control adjusts the filters to about 1200 cps. Types of resistances required for the crossover frequency control are given under "construction details."

#### Treble Amplifier

The output of the high-pass filter net-

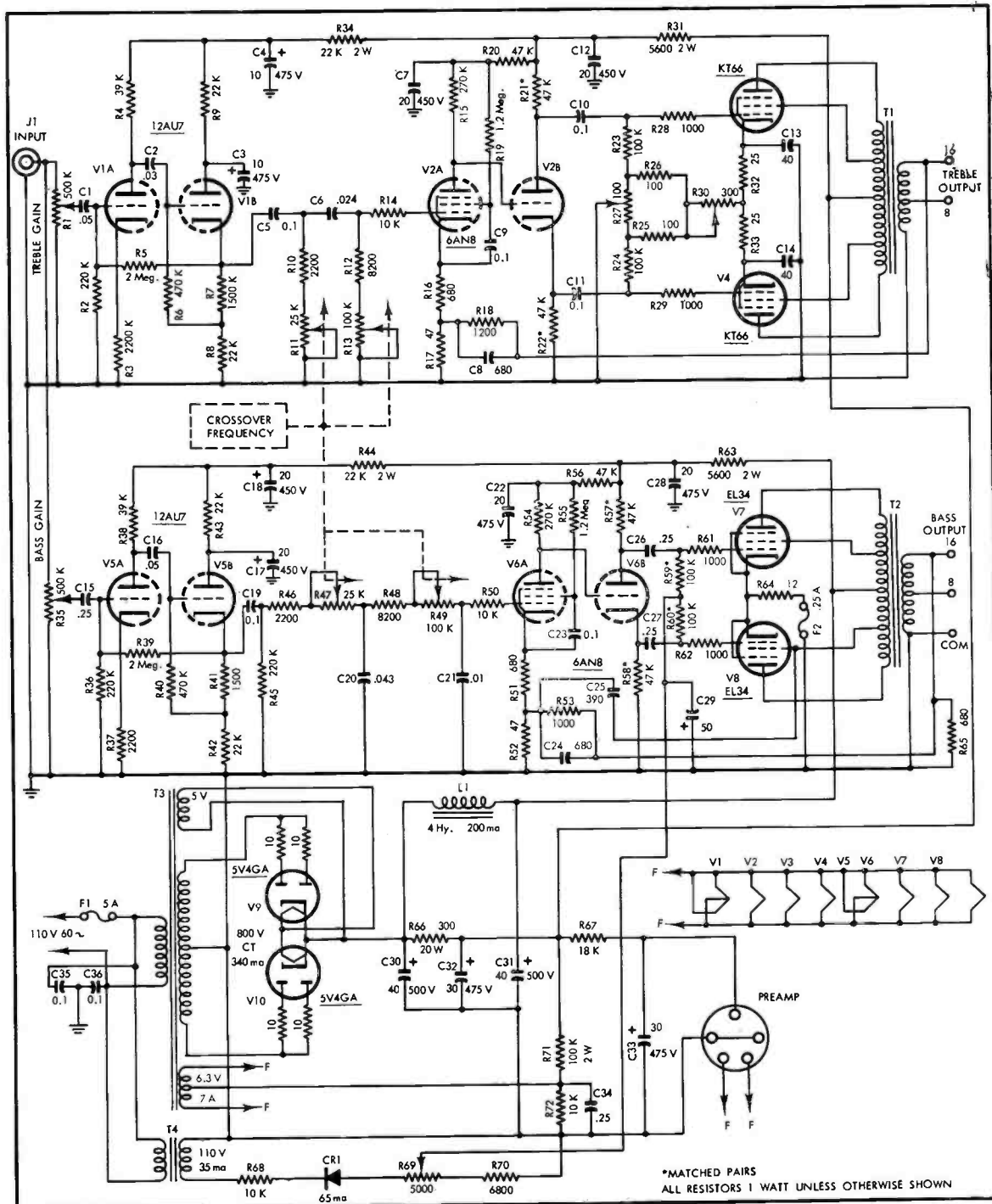
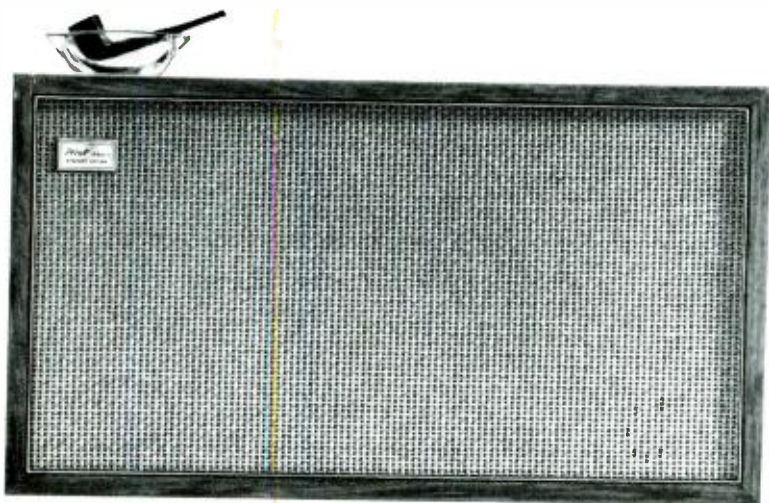


Fig. 2. Over-all schematic of the electronic-crossover amplifier.

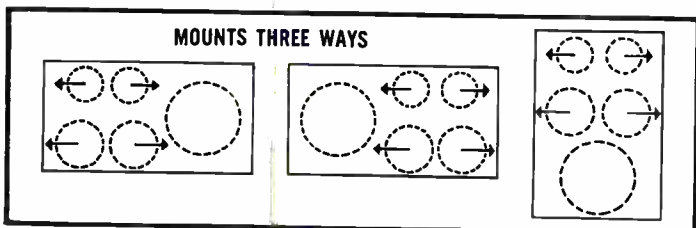
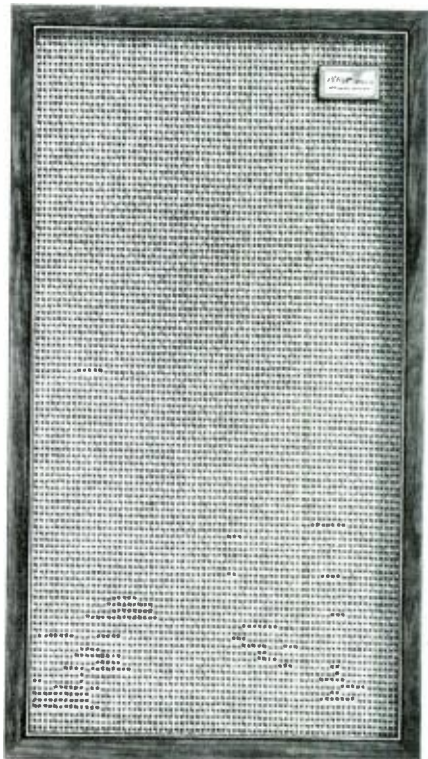




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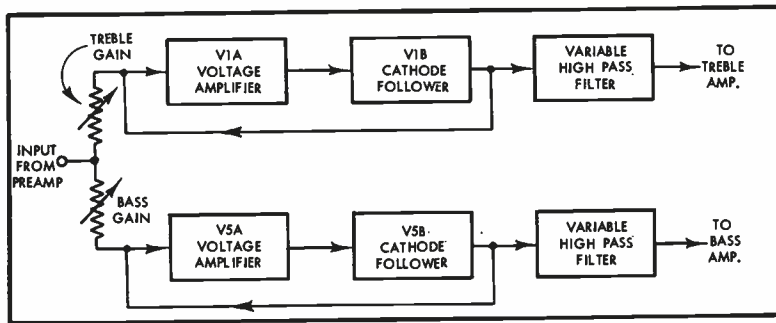


Fig. 3. Block diagram of variable electronic crossover.

work is connected directly to the input of the treble amplifier, Fig. 2. This particular amplifier circuit, which is essentially that of the Dynakits was used because of its simplicity and excellent performance. The treble amplifier contains only three tubes and a relatively small number of parts. Power output is 20 watts with slightly less than 1 per cent total harmonic distortion. Intermodulation distortion is 1.3 per cent at 20 watts output and is under 0.5 per cent at 10 watts.

(Note: Since the photograph in Fig. 1 was taken, transformer  $T_1$  has been changed from a Linear Standard LS-63 to an Acrosound TO-300. Plate-to-plate impedance of the LS-63 was found to be too high for the KT-66 type tubes when operated in the Ultra-Linear connection.)

A few eyebrows may be raised when seeing a 20-watt amplifier being used for the "Treble" range. However, when using a crossover frequency of 200-300 cps, some rather low frequencies must be amplified by the treble channel. A

20-watt amplifier seemed to be a good companion to back up the bass amplifier which is rated at 50 watts.

Tube  $V_2$  is a pentode-triode. The pentode (section A) is used as a high-gain voltage amplifier. It is directly connected to the triode (section B) which is used as a cathodyne or split-load phase splitter. Grid return for  $V_{2A}$  is through part of the high-pass filter,  $R_{12}$  and  $R_{13}$ . The output of the phase splitter is connected to  $V_3$  and  $V_4$  (KT-66's) which are operated in Ultra-Linear push pull. Total plate current of 120 milliamperes (60 ma per tube) is obtained by adjusting the slider on resistor  $R_{30}$ . Resistor  $R_{27}$  is used to balance plate currents. A balance is obtained when the voltage across resistors  $R_{32}$  and  $R_{33}$  is zero. Plate current is the correct value when the voltage across each of these resistors is 1.5 volts. Resistor  $R_{18}$  provides about 18 db of negative feedback. Taps on the primary winding of transformer  $T_1$  provide the necessary screen feedback for Ultra-Linear operation of the output tubes.

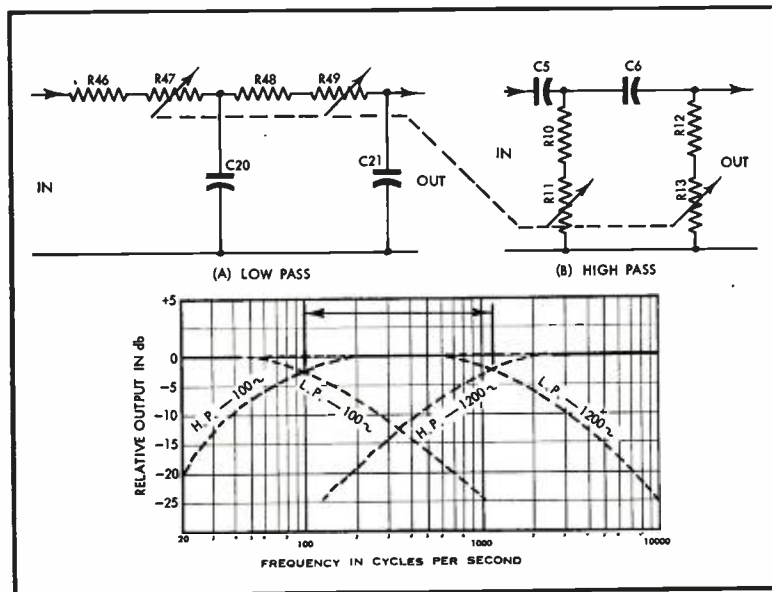


Fig. 4. Configuration of RC filter networks used in the bi-amplifier: (A), the low-pass section, and (B), the high-pass section. (C), response curves of the two sections at maximum and minimum crossover frequencies.

The circuit of the bass amplifier is similar to that of the treble amplifier. Tube  $V_5$  is used as a voltage amplifier and phase inverted which drives two EL-34 tubes also in push pull Ultra-Linear operation. Fixed bias is obtained from a rectifier in the power supply. The bass amplifier develops 50 watts at 0.76 per cent intermodulation. Resistor  $R_{62}$  serves two purposes: It provides a test point for proper plate current (1.56 volts) which in effect is added to the fixed bias, and since  $R_{62}$  is unbypassed it produces a small amount of current feedback. Any unbalance in grid signal or a.c. plate current causes a negative voltage across the resistor. The feedback voltage reduces distortion that may be caused by the unbalance. Resistor  $R_{51}$  provides the necessary feedback.

#### Power Supply

The power supply furnishes 130 ma at 420 volts for the treble amplifier, 140 ma at 450 volts for the bass amplifier, 20 ma at 300 volts for a preamplifier, and 30 to 50 volts bias for the EL-34's.

Full-wave rectification with two 5V4GA tubes, each having its plates connected in parallel, (the 10-ohm resistors,  $R_{73}$ - $R_{76}$  balance current through the two halves) was used to obtain the 280 ma required by the amplifiers. A separate 1-to-1 transformer,  $T_4$  and a half-wave rectifier  $CR_1$  furnishes the 30-to-50 volt negative bias. Capacitor  $C_{29}$  filters the bias supply. The two B-plus voltages are filtered through separate circuits. The filament circuit is positively biased to about 40 volts by a voltage divider of resistors  $R_{71}$  and  $R_{72}$ .

#### Construction Details

The amplifier is constructed on a heavy-gauge steel chassis base 3 in. high by 14 in. wide by 10 in. deep and has a grille type metal cover. The chassis must be made of heavy steel because two of the transformers each weigh about 14 pounds. The completed amplifier weighs 48 pounds.

Location of parts (Figs. 1 and 5) is very important. The power-supply components are mounted at one end of the chassis, the treble amplifier in the middle section, and the bass amplifier at the other end as far away from transformer  $T_3$  as possible. A steel shield is mounted on the underside of the chassis to isolate the external fields of transformer  $T_4$  and filter choke  $L_1$ . The shield also provides valuable space for mounting parts of the power supply. Tube shields are used on the 12AU7's and the 6AN8's to prevent hum pickup from the partially shielded power transformer.

Filaments were wired by two separate pairs of twisted wires from the power supply section, one pair supplying the power output tubes, and the other supplying the small tubes. The



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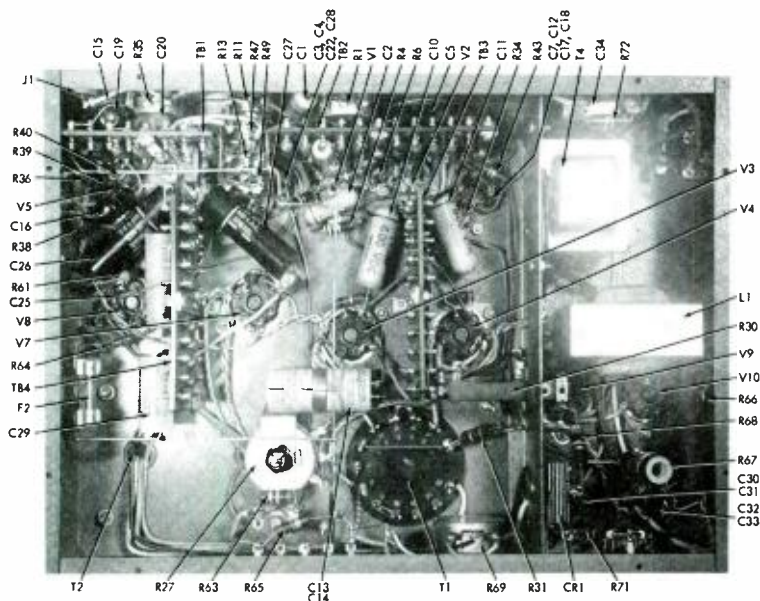


Fig. 5. Underside of amplifier chassis showing ports placement.

filaments were wired first, keeping the leads close to the chassis.

Because of the large number of parts in the amplifier, terminal board construction was used where possible. Two terminal boards are mounted along the front apron of the chassis. These boards mount most of the parts required in the input circuits and the electronic crossover networks. Parts associated with the crossover frequency control are mounted on the boards as close to the control as possible. This allows short leads to the cathode followers and to the grid of the 6AN8's where hum is likely to be picked up. Two other terminal boards mount parts associated with the bass and treble amplifiers. Coupling capacitors were put in last. Terminal board construction makes removal of parts easy, does not clutter the socket pins, and if properly assembled actually reduces capacitance between parts and chassis. The boards were assembled on the bench, then mounted on the chassis and wiring completed.

The crossover frequency control is assembled by using one IRC "PQ" control and three "M" sections all having a linear taper. The control consists of one 25-k "M" section IRC (M11-120), two 100-k "M" sections (M11-128) and a 25K "PQ" standard control (PQ11-120).  $R_{11}$  (standard control) is the basic control and is next to the front apron. Instructions for adding the "M" sections to the "PQ" control are packed with the control. Particular attention must be given to wiring this control since with clockwise rotation of the shaft, resistance must decrease thereby increasing the crossover frequency.

Capacitor  $C_5$  and  $C_6$  in the high-pass

filter and capacitors  $C_{20}$  and  $C_{11}$  in the low-pass filter are selected values that are within 1 per cent of desired value.  $C_6$  was made up by paralleling .02- $\mu$ f and .004- $\mu$ f units then measuring the combination on a capacity bridge.  $C_{20}$  is an .047 $\mu$ f unit that actually measured the desired value of .043 $\mu$ f. Resistors  $R_{10}$ ,  $R_{12}$ ,  $R_{36}$ , and  $R_{38}$ , although standard values, were measured and selected to be within 1 per cent of the desired value. (The author's parts dealer loaned a handful of capacitors and resistors so the correct values could be selected, allowing return of the parts that could not be used, my thanks to him.) Resistor pairs such as  $R_{11}$  and  $R_{22}$ ,  $R_{37}$  and  $R_{58}$ ,  $R_{59}$  and  $R_{60}$ , and  $R_{32}$  and  $R_{33}$  were matched to within 1 per cent. Such exactness may not be necessary but on an overload test, it's nice to see clipping at both grids of each power amplifier take place at exactly the same level.

Some preamplifiers have the 117-volt power switch leads within the cable that

carries power to the preamplifier. These leads were run separately because the primary current of transformer  $T_3$  is about 2 amperes. Ground throughout the amplifier is a #14 tinned bus wire which is connected to the chassis near the input jack. All electrolytic capacitors are mounted on insulating wafers and the shell connected to the ground bus wire. Speaker connections, bias control  $R_{69}$ , and preamplifier power socket are mounted on the rear apron of the chassis. An unusual feature of this amplifier is that it does not contain a single half-watt resistor! It is true that the current in some circuits warrant the use of a half-watt, or even a quarter-watt, resistor but *this* audiofan has encountered several sad experiences with them.<sup>1</sup>

#### Adjustments

The only adjustments required are bias for the EL-34's and balancing the KT-66's. Proper bias (and correct plate current) for the EL-34's is obtained by adjusting  $R_{69}$  until a voltage of 1.56 volts is measured across  $R_{64}$ . The correct balance and plate current for the KT-66's is obtained as follows: Connect a low-range voltmeter across resistors  $R_{32}$  and  $R_{33}$  (pins 8 of  $V_3$  and  $V_4$ ) and adjust resistor  $R_{27}$  for zero voltage. The voltmeter is now connected across  $R_{32}$  (or  $R_{33}$ ) and the slider of resistor  $R_{30}$  adjusted until an indication of 1.5 volts is obtained on the meter. The balance adjustment should be checked by repeating the zero-voltage measurement previously described.

Several "tests" were made on the over-all amplifier such as power output and frequency runs at different crossover frequencies. Figure 6 shows the results of one "run" and indicates the over-all response at an output of 10 watts. Calibration figures on the frequency control (Fig. 1) are approximate only, since in operation the exact value does not mean much.

(Continued on page 83)

<sup>1</sup>One experience similar to that explained by Walter Rieher, in "The sad tale of a half-watt resistor," *Audio*, December, 1957.

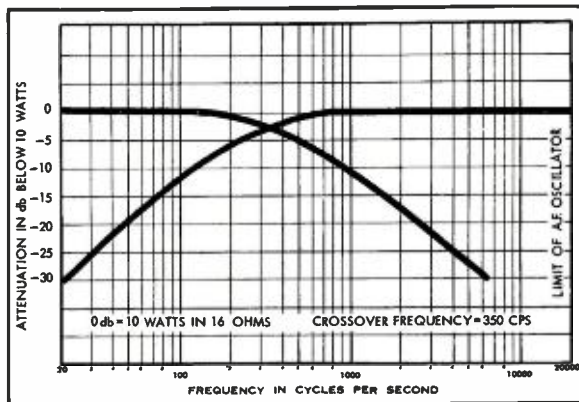


Fig. 6. Response of the two sections of the bi-amplifier with the crossover control set for 350 cps.



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**BOGEN**  
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# Hi-Fi for Lo-Do

S. G. LUCAS\*

While most of us would prefer a factory-built cabinet, the lack of "dough" may make it necessary that we "do" it ourselves. And if you don't have a power saw, it seems likely that there is a lot of the "do" required to turn out this professional-type speaker enclosure.

**A**RE YOU WILLING to gamble less than \$25 and about 10 to 12 hours work for the actual living presence of Bach, Beethoven, Brubeck, or Goodman via this back-loading folded horn for your listening pleasure?

This horn is designed for use with woofers having resonances of about 55 cps but will work very satisfactorily with much lower resonances and slightly higher resonances. The theoretical cutoff frequency is 40 cps but good performance will prevail down to 30 cps.

The cabinet is basically the Jensen Imperial reproducer—a hyperbolic-exponential design (covered by U.S. Pat. 2,338,262)—to be used as a free-standing type for corner or sidewall placement. I plan on installing the Jensen KT-31 speaker kit, but any combination employing a 15-in. woofer or a 2-/or 3-way assembly—such as the Electro-Voice Model 15 TRX; the University Model 315-C; the James B. Lansing Model D130, etc.—can be mounted into this folded horn.

In Figs. 1 and 2—on two 4 ft. x 8 ft. plywood sheets—are shown the lay-outs of the various panels that are needed to construct this speaker cabinet. Below are listed the measurements of these panels, plus the necessary lumber needed for the bracing and the base.

An important point to remember in building your cabinet is that all joints must be accurately fitted and that it must be made as rigid as possible to ob-

## ¾-inch plywood

1	piece
1	"
1	"
1	"
1	"
1	"
1	"
1	"
1	"
1	"
2	pieces
2	"

## Lumber

1	piece
1	"
1	"
1	"
2	pieces
2	"

TABLE 1

22 ½	x	31
24	x	32 ½
32 ½	x	41 ¼
17 ½	x	49 ¼
4 ⅜	x	31
23 ⅞	x	31
15 ½	x	31
4	x	12 ½
11 ¾	x	31
12 5/16	x	31
10 ⅞	x	49 ¼
16 ¾	x	41 ¼

Bottom
Top
Front
Back
Part A
Part B
Part C
Part D
Center Shelf
Lower Shelf
Part E
Sides

1 ½	x	2 ½	x	29
1 ½	x	2 ½	x	40
1 ⅞	x	3 ⅞	x	64 ½
1	x	1	x	76 ½
¾	x	2 ⅞	x	48 ½
1 ½	x	1 ½	x	48 ½

Top Stiffener
Back Stiffener
Base
Cleats
Cleats
Posts

All dimensions in inches

tain the best results. Except for such parts as the base, posts, cleats, and stiffening members, ¾-inch plywood is used throughout. All joints should be adequately glued and screwed to maintain rigidity.

The following construction procedure is suggested: Begin by cutting out the bottom and the front panel and be sure that these first cuts are square to insure a tight fit. The centerline of the speaker opening is 11 ¾ in. from the bottom edge and located on the vertical axis. This opening may be cut to accommodate either a 12 or 15 in. woofer or your present tri- or co-axial speaker. Upon checking the list of materials, you will note that the bottom panel is ¾

in. smaller all around than the top—so be sure you pick the correct one to start your construction. Next, take the corner posts and cut two sides of each with a notch ¼ in. deep and ¾ in. wide, with the upper edge of the notch 8 in. down from the top of the post. Glue and screw these corner posts to the front panel—but be sure and mount them ¾ in. in from the side edge and ¾ in. up from the bottom of the front panel in order to leave room for later fastening the bottom and side panels.

Figure 3 shows how Part A—4 ⅜ x 31—is attached to the notched corner posts and the front panel. I glued and screwed these panels together and with the use of clamps to hold them firm, then let

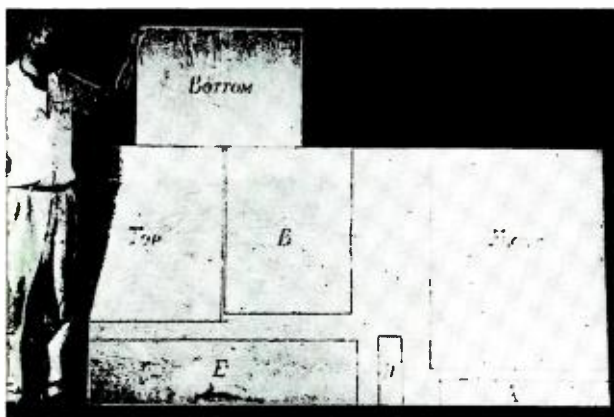
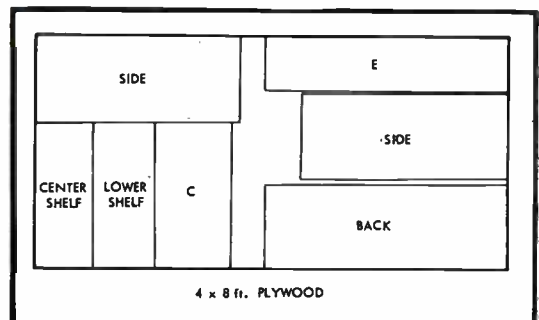
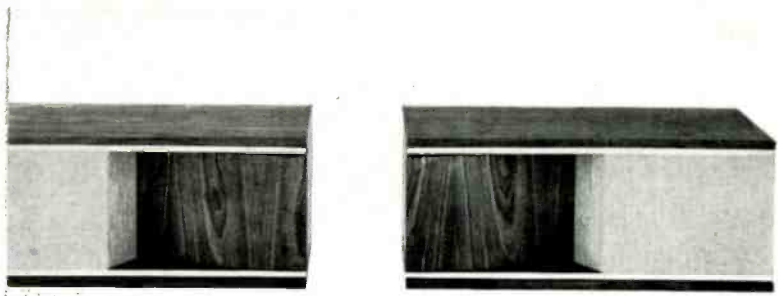


Fig. 1 (left). Layout of one of the plywood sheets is the initial step in the actual construction. Fig. 2 (below). Layout of the second sheet to make sure you get all the parts out of the two pieces of plywood.



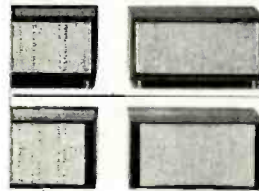
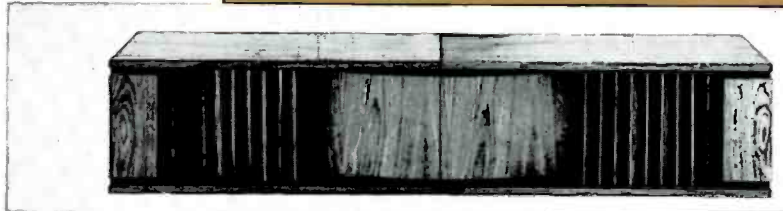


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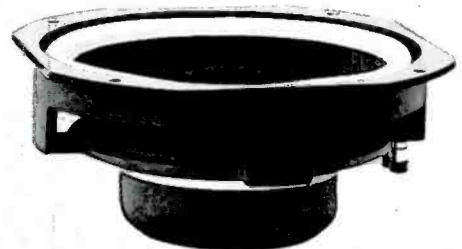


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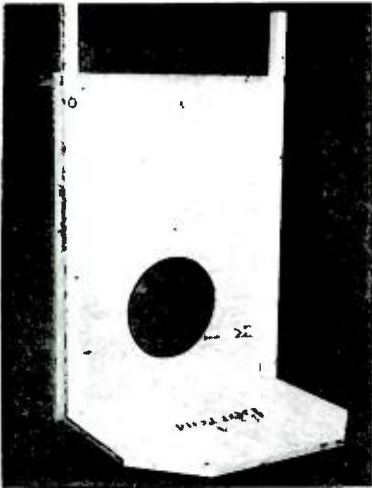


Fig. 3. The two notched corner posts are attached to the front panel, and the base is attached next. Casein glue and plenty of wood screws ensure a solid cabinet.

them set over-night.

Figure 4 shows the installation of the center shelf. First cut this panel— $11\frac{3}{4} \times 31$ —and two pieces of the 1 in.  $\times$  1 in. lumber—one 31 ins. long and the other 28 ins. long. Glue and screw the 1  $\times$  1  $\times$  31 cleat to the rear, lower edge of the center shelf. Next, cut  $1\frac{1}{2}$  in. notches in the forward edge of this panel to fit around the corner posts. At this point, it is necessary to plane the rear edge of Part A and the rear edge of the center shelf approximately 20 deg. to insure a tight fit of the network panel, which is fastened later. Mount the center shelf  $20\frac{3}{4}$  in. down from the upper surface of Part A. As can be seen in Fig. 5, I had nailed some tem-

Fig. 6. Part B and one side installed; lower shelf in place with small stiffening member between it and bottom panel. Also shown are 2  $\times$  4 base members.



Fig. 4. Installing the center shelf. Note that two pieces of 1  $\times$  1 have been attached to the shelf before mounting on the front panel.

porary braces to the ends of the center shelf and the corner posts to position these pieces securely until ready for the next step.

Cut Part B— $23\frac{1}{8} \times 31$ —with a 12 in. square opening cut in the center. Bevel the top and bottom edges of this panel to form a level plane with the upper surface of Part A and the lower surface of the center shelf. Now lay the cabinet assembly face down and glue and screw Part B into position. At this point it is best to add a side panel to give additional support to the bottom. If your speakers have any Tone or Balance Controls it is necessary to cut the needed holes in the side panel before mounting. Also, don't forget to bevel the rear edge of the sides at 45 degrees to make a smooth fit with Part E.

The above steps are shown in Fig. 6, along with the lower shelf being added. Cut this panel— $12\frac{5}{16} \times 31$ —and slightly bevel the rear edge approximately 6 deg. to insure a tight fit with Part C. Take Part D— $4 \times 12\frac{1}{4}$ —and bevel it so that it is 4 in. at one end and  $2\frac{3}{4}$  in. high at the other end. Glue and screw Part D to the center of the lower shelf. Then mount this assembled lower shelf on to the bottom panel so that the front edge of this assembly is  $2\frac{3}{4}$  in. away from the inner surface of the front panel and with the slant pointing down toward the front. Along at this time, you can cut two pieces of  $2 \times 4 \times 16\frac{3}{4}$  and one piece  $2 \times 4 \times 31$  with the ends mitered, for use as a base. Mount these pieces to the bottom as shown in Fig. 6—the piece running across the back edge is just a temporary brace—which is removed later when the casters are added.

Figure 7 shows how the various panels were glued previous to adding the remaining side. Note the clearance be-



Fig. 5. Making ready for the installation of Part B. Note the use of temporary braces along the sides to keep the center shelf in the correct position.

tween the lower shelf and the corner posts. Also shown is the speaker compartment panel, Part C— $15\frac{1}{2} \times 31$ —with an access opening of  $12 \times 17$  cut in the center. After this panel has been glued and screwed to the center and lower shelf, the other side can be mounted.

Figure 8 shows a rear view of the cabinet with Parts E mounted. Remember to bevel the rear edges of Parts E at 45 deg. At this point it is necessary to cut two rabbets  $1 \times 3 \times 48\frac{1}{2}$  beveled 45 deg. at one edge—these can be seen mounted at the rear of the inside of Part E, so that the 45-deg. bevel is such that it will form a 90 deg. corner in which the back panel will fit.

Fig. 7. The structure progresses—part C, with the large rectangular speaker-access opening, has been installed. Note space between lower shelf and corner posts.



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Power for orchestral climaxes with full concert-hall brilliance... yet mellow in tone, undistorted! You can build this high speaker power into your new equipment at a cost *one-third less* than the cost of other tubes with comparable performance!

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<b>Plate dissipation</b>	<b>30 w</b>
<b>Screen voltage</b>	<b>450 v</b>
	<b>(500 v with output transformer taps)</b>
<b>Screen dissipation</b>	<b>5 w</b>
<b>Cathode current</b>	<b>110 ma</b>

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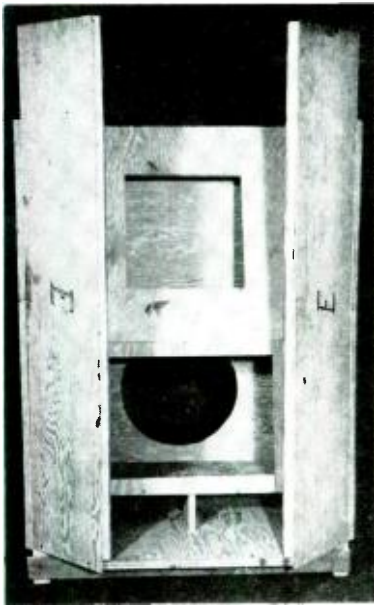


Fig. 8. The remaining side and parts E are now mounted in place, resulting in this appearance.

The top of the cabinet can now be attached. Add a stiffening member— $1\frac{1}{2} \times 2\frac{1}{2} \times 29$  across the middle of the under side of the top. At the same time, a cleat— $1 \times 1 \times 15$ —beveled at 45 deg. at each end mounted at the rear of the top panel  $\frac{3}{4}$  in. in from the edge—to provide a screwing surface for the removable back panel.

As shown in Fig. 9, it is wise to caulk all joints with a material such as linoleum cement or any compound which will not become brittle with age. It is very important that all enclosure joints

should be air-tight and that is why a liberal use of glue, wood screws and a caulking compound should be used. The best test for adequate rigidity is to thump the center of all panels with a clenched fist; a vibrating panel will quickly reveal its presence by the hollow, drummy sound indicating additional bracing is needed.

Check Fig. 8—after installing your speaker to the opening, it is necessary to drill a small hole in the center shelf to pass the lead up to the network compartment. Cut a panel— $14 \times 19$ —as a cover to the opening of the lower compartment and fasten with  $1\frac{1}{2}$ -in. wood screws on approximately 6 in. centers.

Next, cut a panel 14 in. square. Mount all your network units on this panel, drill a small hole in this panel as an opening for the leads, and then fasten securely to the  $12 \times 12$  opening. Remember that any small holes drilled for insertion of leads, should be made air-tight with the application of a plastic wood cement.

If you have a midrange and/or super-tweeters, they are to be mounted in the upper compartment on Part A and any controls can now be affixed.

After all speakers, networks, and controls have been mounted, the back panel can be attached. To the vertical center-line of the back, a stiffening member— $1\frac{1}{2} \times 2\frac{1}{2} \times 40$ —should be fastened. One small hole should be drilled in the back panel through which the input lead can be fixed. The removable back can now be placed into position and screwed securely.

Figure 10 shows the completed cabinet with no speakers, networks, or leads attached. Be sure to putty in all the countersunk screw holes.



Fig. 9. In addition to the liberal use of casein glue, as shown here, it is desirable to caulk all joints with a non-hardening compound, such as linoleum cement.

Figure 11 shows grill cloth secured to the upper speaker compartment, and with the excess grill cloth temporarily mounted on the front panel. Due to the size and weight of this cabinet, it was felt necessary to mount wheels to facilitate ease of handling.

At your local hobby shop or wallpaper dealer, it is possible to buy deal veneers, such as "Contact" to dress up this cabinet—the final appearance is unlimited, and the more experienced constructor may take the trouble to veneer the entire unit in a hardwood finish.  $\text{Æ}$

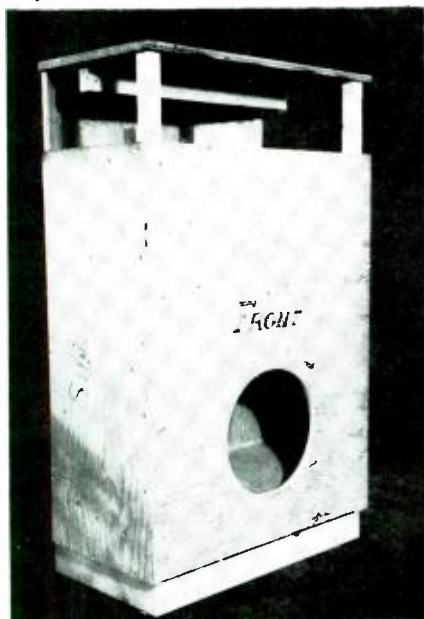
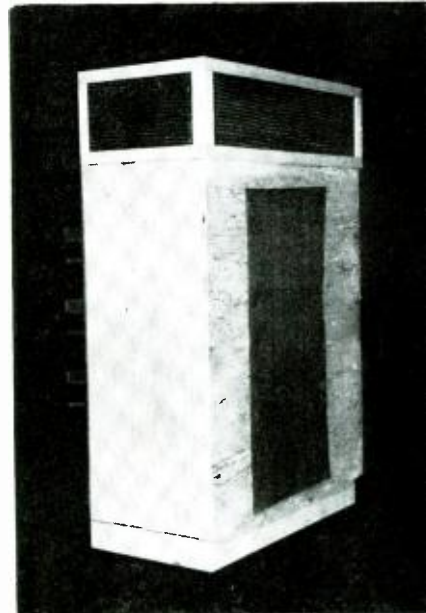


Fig. 10 (left). Cabinet is complete except for trim, finishing, and installation of speaker and network components. At this point it should be thoroughly solid and non-resonant.

Fig. 11 (right). Grille cloth installed in upper section and on front panel. A "picture frame" type of moulding will cover edges of grille cloth. Cabinet may be painted, veneered, covered with "Contact" decal, or simply left as shown, depending on the degree of personal freedom enjoyed by the builder.







# A *Bozak* FOR EVERY MUSIC LOVER

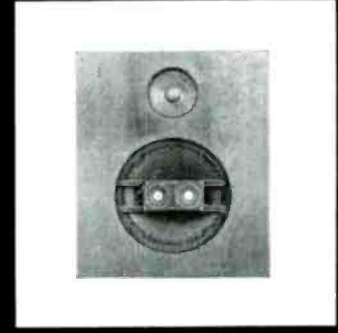


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# Errors and Mistakes of Engineers

ALBERT WOODRUFF GRAY\*

**Architects, engineers, and consultants can not usually be held liable for failures in their work—they must exercise due diligence like physicians and lawyers, but successful results are not necessarily guaranteed.**

**O**VER A HUNDRED YEARS ago by a New England court was outlined the rule that governs the liability of an engineer or any other professional worker in his performance of services.

"What then is the contract of the professional man with his employer in regard to his qualifications and conduct," queried that court. "And here it may be laid down broadly, that without a special contract for that purpose he is never a warrantor nor insurer. He never stipulates for success at all events and he is never to be tried by the event.

"By our law a person who offers his services to the community generally or to any individual for employment in any professional capacity as a person of skill, contracts with his employer that he possesses that reasonable degree of learning, skill, and experience which is ordinarily possessed by the professors of the same art or science and which is ordinarily regarded by the community and by those conversant with that employment, as necessary and sufficient to qualify him to engage in such business."<sup>1</sup>

Even earlier than this pronouncement by that New Hampshire court is an English case in which it was asserted, "every person who enters into a learned profession undertakes to bring to the exercise of it a reasonable degree of care and skill.

"He does not, if he is an attorney, undertake at all events to gain the cause nor does a surgeon undertake that he will perform a cure. Nor does the latter undertake to use the highest possible degree of skill, as there may be persons of higher education and greater advantages than himself, but he undertakes to bring a fair, reasonable, and competent degree of skill."<sup>2</sup>

In the circumstances surrounding a lawsuit in New York State the humanity and justice of this old common law rule became apparent. There an engineer had written to a company, "I am to act as consulting engineer in your company and to assume entire responsibility for the design and construction, devoting as

much time to this work as may be required. In consideration of being retained I agree not to engage in consulting work for clients in similar or competitive lines of work."

Five months later the engineer was requested to resign. This he did with the agreement that he would be given two months salary in place of the usual notice. When the company failed to pay this advance, suit was brought by the engineer for the amount he claimed as due under his employment contract.

As a counterclaim the company demanded \$10,000 for expenses it had incurred which would have been avoided, the company claimed, if the engineer had properly performed his work as a consulting engineer.

"It would, I think, be a violent construction of this contract," said the court in refusing to recognize any liability as resting on the engineer under this charge of his employer, "to hold that this engineer intended thereby to guarantee the sufficiency of the plant which was to be erected under his care. I think a fair interpretation of this contract would hold the engineer to an obligation to assume full charge of the construction of the work and to use his best endeavor to accomplish that purpose."<sup>3</sup>

## Charges of Negligence

A very similar situation had been before the Florida courts the year before, but in that instance the charges of negligence and lack of skill had been made against architects instead of engineers. There as in the New York decision, the errors or mistakes of the architect in this instance, or of the engineer in the former action, afforded no grounds for the claim of negligence in the performance of the services.

"The architect's undertaking," said the Florida court, does not imply or guarantee a perfect plan or satisfactory result and there was no evidence sufficient to support a verdict of the existence of a specific promise or guarantee."

To this statement was added an outline of the legal obligations of a professional worker. "The law requires only the exercise of ordinary skill and care in the

light of the present knowledge. If the plans and specifications were in fact justified by the common knowledge upon such matters at the time and met the judgment of approval of those men ordinarily skilled and experienced in their conclusion, the architect has complied with his contract."<sup>4</sup>

This charity bestowed by the courts on the honest mistakes of engineers and other professional workers in the performance of their undertakings was extended by a court in the District of Columbia a few years ago to relieving an engineer of consequential damages when the correction of the mistake was timely made.

Consulting engineers had been employed to prepare plans and specifications and on the basis of those plans, contracts had been made for the performance of construction work. In the specifications was discovered later a mathematical error and corrected plans were immediately prepared. By the court in this instance there was charged against the engineers only the additional cost resulting from the mistake.

"The engineers," said the court, "contracted to furnish plans. They did not contract to install the system or guarantee that the system would be installed for any specified sum. Through negligence they failed to furnish the proper plans but when such negligence was discovered they supplied supplemental plans which together with the original plans filled their contract obligation.

"Had the original plans been free of error the cost would have been \$183.30 less than in the use of the original plans. Such amount places the owner in the same position it would have been in if the error had not been committed. A larger sum would permit the owner to profit by the engineer's mistake."<sup>5</sup>

This feature of the obligations of engineers, carried a step further, appeared in a recent South Carolina controversy in which engineers had obviously failed to exercise the care and skill demanded

(Continued on page 102)

\* 112-20 72nd Drive, Forest Hills, N. Y.

<sup>1</sup> Leighton v. Sargent, 27 N.H. 460, December, 1853

<sup>2</sup> Lanphier v. Phipos, 173 Eng. Rep. 581, February 16, 1838

<sup>3</sup> Butkley v. Kaolin Products Co., 187 A.D.103, New York, March 21, 1919

<sup>4</sup> Bayshore Development Co. v. Bonfoey, 78 So. 507, Florida, March 20, 1918

<sup>5</sup> Henry J. Robb, Inc. v. Urdahl, 78 Atl. 2d 387, District of Columbia, January 31, 1951

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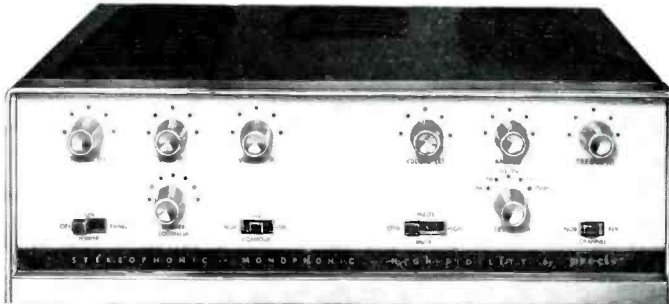
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# TRANSISTOR MUSIC SYSTEM USING DIRECT COUPLING

(from page 24)

used in the common-emitter connection. Low-noise operation of  $Q_{11}$ , a PNP type, results from operating its collector at only 0.25 volt and 35  $\mu$ a. Using two PNP stages followed by an NPN stage allows the collector operating point of  $Q_3$  to be near ground potential which is convenient for the feedback connection to  $Q_{11}$ .

Unity d.c. feedback from the collector of  $Q_3$  to the base of  $Q_{11}$  establishes a high degree of temperature stability for all three stages over the range of 32 to 125° F. At audio frequencies the input and feedback networks tailor the response to the RIAA curve. A  $\pi$ -section RC low-pass filter at the input flattens the phono pickup peak in the 10 to 20 kc region and at the same time prevents rectification of local radio station carriers, a serious problem in many locations.

Following the phono preamplifier four channels are mixed at the input of the four transistor tone control section  $Q_4$ ,  $Q_5$ ,  $Q_6$  and  $Q_7$ . Each input has an r.f. filter. This amplifier is similar to the phono preamplifier except for the addition of an emitter follower  $Q_7$ . Again direct coupling and feedback are used to temperature-stabilize the four transistors at once, determine the gain characteristics, and provide BASS and TREBLE control action.

Stabilization of the feedback at high frequencies is accomplished as in the power amplifier by means of local loops through small capacitors. In the tone control section there is a stabilizing capacitor from the emitter of  $Q_7$  to the base of  $Q_6$ , from the emitter of  $Q_7$  to the base of  $Q_4$ , and from the emitter of  $Q_5$  to the base of  $Q_4$ . A 100-ohm isolating resistor in series with the TAPE OUTPUT jack prevents the phase lag due to line capacitance from causing instability.



Fig. 12. Square-wave response at the tape output at the flat setting of the tone controls.

Both the TAPE OUTPUT signal from the tone-control amplifier and the MONITOR playback signal from the tape recorder are mixed at the input of a similar four-stage output amplifier  $Q_8$ ,  $Q_9$ ,  $Q_{10}$ , and  $Q_{11}$ . This section equalizes the speaker response at low and high frequencies by means of selective feedback.

for a greater range of bass boost than attenuation and a greater range of treble attenuation than boost.

When the tone controls are set at their flat positions the response is flat within 0.1 db from 10 cps to 100 kc as shown by the lower curve, Fig. 11. As a result of the gradual attenuation above 100 kc the square-wave response, Fig. 12, is excellent and exhibits no high-frequency ringing. The phono input is RIAA compensated within 1 db from 30 to 10,000 cps. Its response curve, Fig. 13, was measured at the TAPE OUTPUT with an ESL C60 pickup playing an RCA No. 12-5-49 test record.

Equalization for the speaker system, measured at the main OUTPUT with the tone controls at their flat positions, is

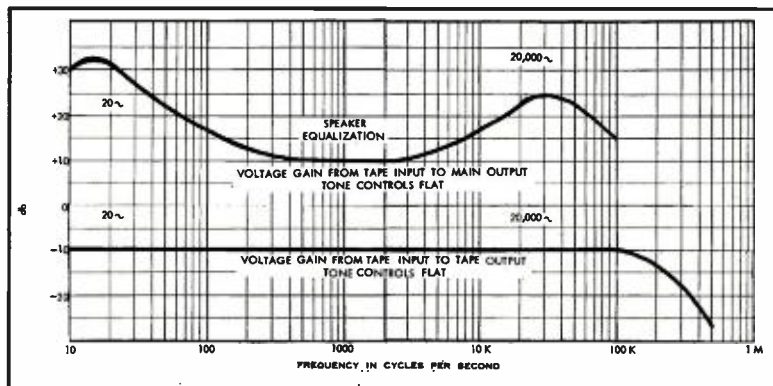


Fig. 11. Response at the main output and the tape output at the flat setting of the tone controls.

## Performance

Figure 10 shows the response from the TAPE input to the TAPE OUTPUT. The tone-control action and the final component values were determined by listening tests on a wide variety of program material. These tests indicated the need

22 db at 20 cps and 13 db at 20 kc. This response, shown by the upper curve in Fig. 11, was determined primarily by extensive listening tests using the response curves of the woofer and tweeter measured by a close microphone as guides.

As a result of the high feedback factor

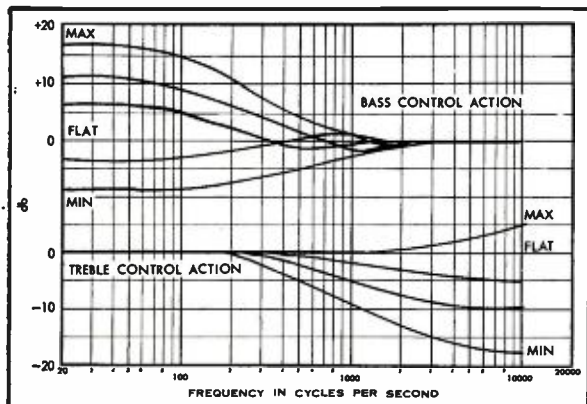
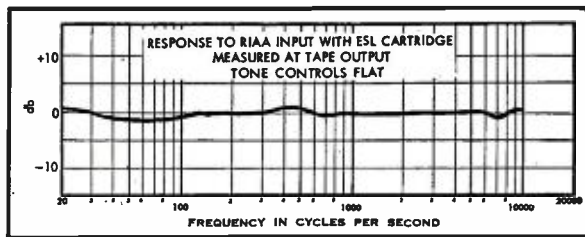


Fig. 10 (left). Bass and treble controls balance the response without losing extreme low and high frequencies. Fig. 13 (below). Phono preamplifier and ESL-C60 pickup response.



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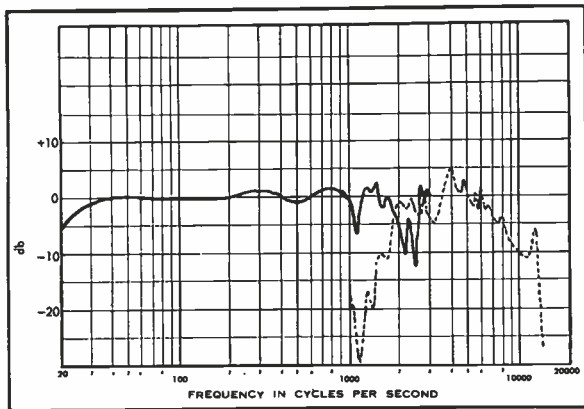


Fig. 15. System acoustic response with doors open.

in: each section of the tone-control pre-amplifier, harmonic distortion is very low. A 1-volt rms signal at the TAPE OUTPUT, which is 10 db above the normal level, has less than 0.05 per cent total harmonic distortion from 20 to 10,000 cps at any control setting. The MAIN

from a low-impedance source, is -73 to -79 db depending upon the control settings. Since each input will handle 10 db more than its rating, signal-to-noise ratios as high as 83 to 89 db can be attained. When the master VOLUME control is turned to zero the output noise

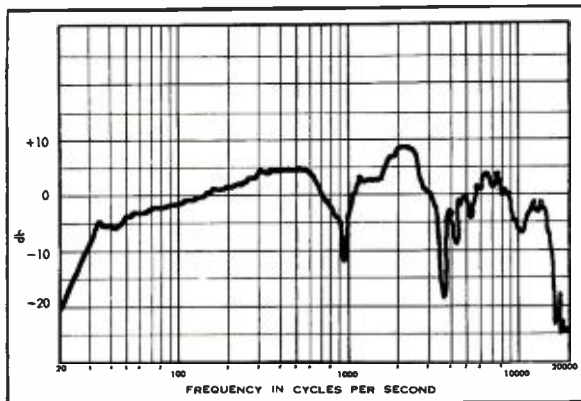


Fig. 16. System acoustic response with doors open. Microphone of 2 feet on center.

output also delivers 1 volt rms from 20 to 10,000 cps. This level is 8 db above the 0.4 volts needed to drive the power amplifier to 20 watts output. Limiting at higher output signals is symmetrical when the load is 3300 ohms.

Noise referred to either the TAPE, RADIO, or MICROPHONE input, when fed

decreases to below audibility at 1 foot from the speaker.

At the phono input the noise is remarkably low, about -74 db referred to a peak velocity of 10 cm/sec at 400 cps. The absolute level is less than 0.15  $\mu$ v referred to the input when based on the 50-cps gain.

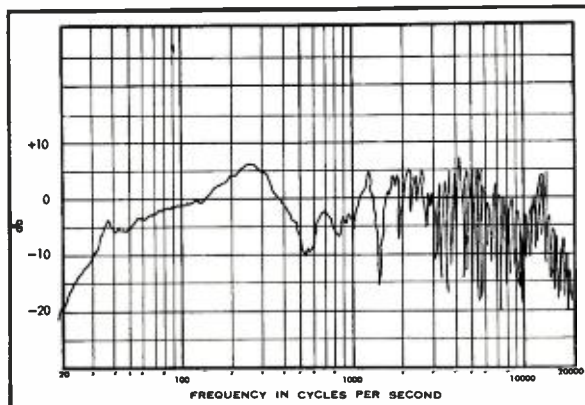


Fig. 17. System acoustic response with doors open as in Fig. 14. Microphone of 2 feet on center.

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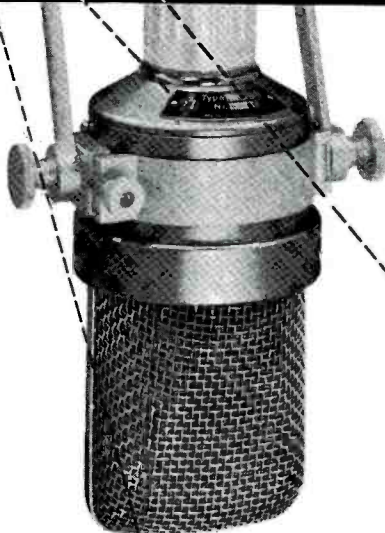
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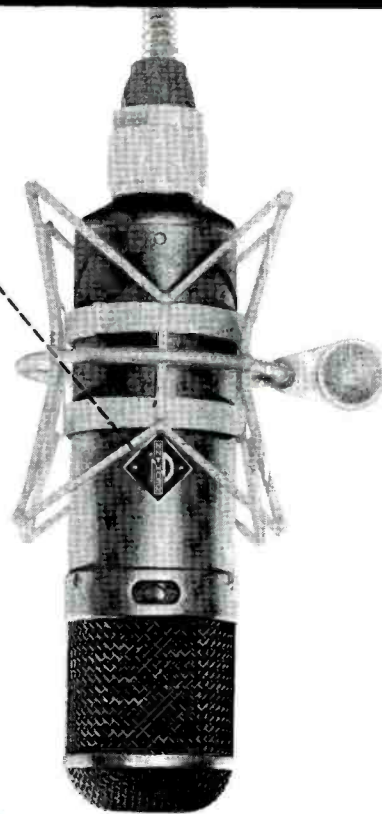
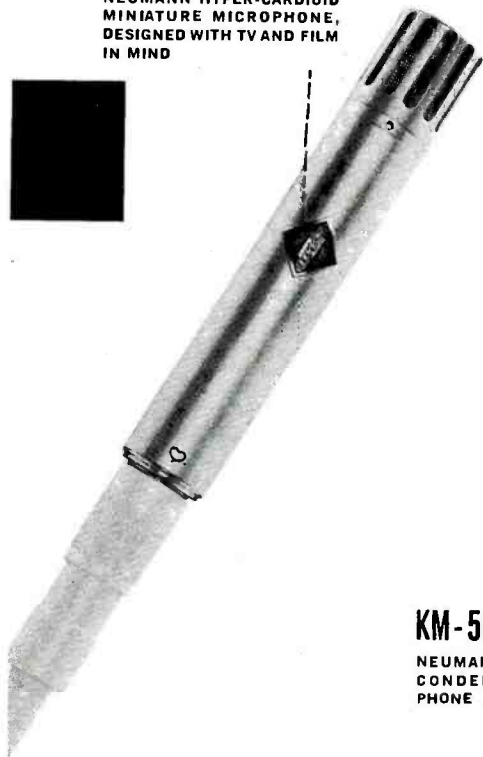
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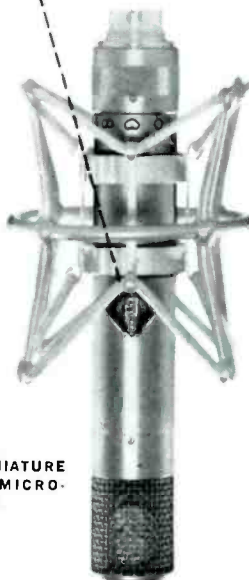


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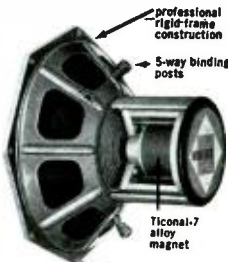
Model	Size	Power (watts)	Efficiency	Total Flux (Maxwell)	Frequency Response (cps)	Audiotape Net
AD-5277M	12"	20	30	134,000	35-18,000	\$72.50
AD-4277M	12"	20	30	98,000	35-18,000	39.00
AD-4777M	8"	6	10	58,300	50-20,000	26.00
AD-3800M	8"	6	10	26,200	75-19,000	9.90
AD-3300M	5"	3	5	26,200	30-19,000	8.34
AD-3690M	6x9"	6	9	26,200	70-18,000	7.95
AD-2690M	6x9"	6	9	15,200	70-14,000	6.75

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### Speaker System

To produce a smooth musical sound the speaker system incorporates its own reverberation chamber. Two hinged doors forming an adjustable triangular chamber in front of the closed box speaker enclosure, Fig. 14, reflect the sound numerous times in a random manner. Their effect in listening is rather similar to placing the speaker system in a live listening room.

The enclosure itself is a 2.3-cubic-foot closed box or infinite baffle completely filled with sound absorbing material. It contains a Lansing Model D130 15-inch woofer and a Jensen Model RP-103 horn-type tweeter. An earlier enclosure design used a ducted bass-reflex port. The tweeter and several convex sound reflectors were built into the port which then acted as a reverberation chamber for the tweeter. Changing to a closed box and re-equalizing has permitted extension of the bass range of the entire music system from 80 cps down to 20 cps. The larger reverberation chamber formed by the doors produced reverberation for both the woofer and the tweeter, resulting in a smoother sounding crossover.

Contrary to the present trend toward inefficient woofers in which the middle-range efficiency has been lowered to match that of the bass range, this system uses a woofer having a 4-inch voice coil which makes one of the most efficient motors obtainable. As a result of the high efficiency the bass response falls off in a nonresonant manner which can be equalized by the relatively simple RC feedback network in the output amplifier of the control unit. Flattening the response by means of electrical equalization instead of mechanical produces a wider bass range and up to 10 db more acoustic power output on program material having moderate bass energy content.

A single 10-µf nonpolarized electrolytic capacitor in series with the tweeter comprises the crossover network. The average impedance of the system is about 10 ohms.

Curves of the equalized speaker response, made outdoors with a very close microphone are shown in Fig. 15. For these measurements the speaker system was placed face up on the ground with the doors folded back against the sides. A calibrated Altec type 21-C microphone was placed ½ inch from the grill cloth in front of the woofer to measure the solid curve and 4 inches from the grill cloth on the axis of the tweeter to measure the dashed curve. The remarkably flat response of the woofer and speaker equalizer within ± 2 db from 25 to 1000 cps indicates that the motion of the cone

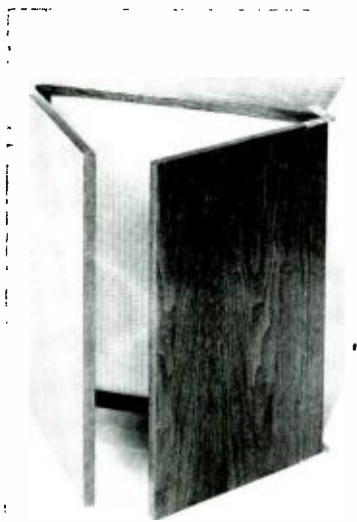


Fig. 14. Closed-box speaker system. Doors form reverberation chamber.

is well controlled in this region. Although the system could have been equalized for flatter response above 5000 cps, listening tests indicated that further high-frequency compensation was undesirable even on live program material.

When the microphone is moved to a distance of 2 feet on the axis of the speaker system, the measured frequency response, Fig. 16, is entirely different. This curve was measured by an equalized Western Electric type 640AA microphone in the Harvard anechoic chamber. A high-pass filter in the measuring system attenuated frequencies below 50 cps. A peak at 4000 cps in the tweeter response, Fig. 15, has now become a valley due to cancellation from the woofer. At 50 cps the response is down nearly 10 db from that at 500 cps. Listening tests indicated that increasing the bass compensation to flatten this curve made the system sound boomy in most locations. The compensation which produced flat response with the close microphone, Fig. 15, seemed to be optimum.

As would be expected, partially closing the doors in front of the enclosure as in Fig. 14 produced multiple reflections which resulted in a great many peaks and valleys in the response, Fig. 17. Surprisingly the musical quality with this jagged curve is much smoother than that with the doors open.

The foregoing techniques have produced a compact music system having both high performance and ear appeal.

#### REFERENCE

Burwen, Richard S., "Portable transistor music system" *Journal of the Audio Engineering Society*, Vol. 6, No. 1, January 1958, pp 10-18.



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INPUTS: 14 total; 3 dual high-level and 4 dual low-level.

OUTPUTS: Dual tape outputs, separate preamp output as well as standard dual speaker outputs.

#### HUM AND NOISE LEVEL:

High Level Input: 80 db below rated output.

Low Level Input: 70 db below rated output.

Tape Input: 65 db below rated output.

SPEAKER CONNECTIONS: 4, 8, 16, 32 ohms.

#### SENSITIVITY FOR RATED OUTPUT:

Aux Input: .75 V Phono 1: (Magnetic) 5 Mv.

Tuner: .75 V Phono 2: (Magnetic) 5 Mv. or Ceramic .3V

INVERSE FEEDBACK: 25 db

DAMPING FACTOR: 22

BASS TONE CONTROL RANGE:  $\pm 15$  db at 50 cps.

TREBLE TONE CONTROL RANGE:  $\pm 15$  db at 10 Kc.

RUMBLE FILTER: 6 db per octave below 50 cps.

EQUALIZATION: Phono: "RIAA"; "EUR";

Tape: 3% and 7 1/2 ips, NARTB

TAPE OUTPUT LEVEL: 2 volts per channel.

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(Reading time: 2 minutes)

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cally illustrated by its space-saving size. The entire system blends beautifully with your favorite decor and fits any size room. So light-in-weight you can easily carry all the components home yourself. Weathers TRIOPHONIC STEREO is truly a miracle in both sound and size!

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## AUDIO ETC

(from page 16)

### 2. CARTRIDGES

In the general enthusiasm for our developing stereo equipment this last spring I was given so many new stereo cartridges to try out that I ended up more confused than enlightened. Since my "testing" is always strictly practical use and ear-listening, the thing to do was to put these cartridges to work and see what happened. I hooked them all up into my interchangeable plug-in (four-wire) system, tried a couple in a changer, as well as in a manual turntable set-up, and went about my business of playing records by the dozens—and listening, not to the cartridge but to the music. That's what counts, after all.

I'm going to have to beg off any detailed report on each one of these numerous excellent stereo cartridges; there were too many for my ears. I'll offer a few generalizations, though, plus a few side-comments on one or the other, and hope that the persevering cartridge makers will forgive me for having only one set of ears.

#### GE

General Electric is one up on me—the company has brought out a new stereo cartridge, the VR-22 type, before I so much as got around to discussing the first one. I haven't seen the new model but I gather it is an outgrowth of the earlier design rather than a wholly new departure in cartridge construction—so perhaps my remarks herewith will apply to the whole present GE stereo line of cartridges.

What I have to say is simple enough. The GE magnetic cartridge has from the beginning been aimed at a very specific place in the phonograph world and has been tailored with exquisite care to fit its basic purpose—a simple, efficient, mass-produced cartridge that in volume production can give a maximum value at a minimum price.

It takes a very large company to swing a project of that sort and GE has the size and the umph to do it. But as we all know, the larger a mass-production project gets, the more crucially important are the exact details of the manufacturing process. Such a product is 90 per cent designed around production—quick, simple manufacturing. The most minute details, even down to the diamond point itself, must be planned for volume operation. The tiniest miscalculation, from this special viewpoint, can spell disaster on a relatively huge scale.

It has been GE's purpose and GE's accomplishment through these years to achieve maximum cartridge value in these very special terms, as I see it. The intention is utterly different from that of a cartridge such as, say, the Grado, which is deliberately designed for top excellence on an individual basis, virtually hand-made. These differences in emphasis are little known to the general public but every manufacturer knows them all too well. The very first consideration in every piece of manufacturing design must be to choose the

exact area of contemplated production and shoot precisely for it, down to the last screw and wire and hunk of solder—if any.

With this prelude, it seems to me that we can look at the GE cartridge and see precisely where it stands—today as in the past. There was much initial criticism of the GE stereo on the glaringly obvious ground that the stereo model used basically the same two coils as the mono version before it and thereby sacrificed the obviously valuable hum-bucking qualities of the double-coil arrangement.

Does anybody think GE didn't know this? Don't be silly. Of course the GE design people knew all about it (or they wouldn't deserve a grade-school diploma in elementary science). But the likely alternative, a double-double-coil design, four coils and dual hum-bucking, was one of those fatal traps that GE unerringly avoided. In the GE-type operation, this was just plain out of the question. The added cost would simply kill the basic concept of the cartridge, which is a simple product to sell at a fabulously low price in huge volume.

Perhaps you'll remember the Model T Ford and the old Ford idea that the \$300 auto could be painted "any color so long as it was black." Without implying any direct comparison between GE and Ford T, I suggest that the old Ford concept was just as delicately calculated as the new GE cartridge concept and that, in the old days, the addition of rainbow colors to the model T would have been basically just as costly, as prohibitively uneconomical in the manufacturing, as the use of double coils in the original GE stereo model. After all, how much Ford do you buy now for \$300—or \$600, taking account of the dollar's change?

Moreover, I suspect, and believe, that GE did some marvelously careful calculating on this hum problem. It was a risk, a neatly calculated one. I think I can get away with saying that the first GE stereo cartridge did, indeed, as I used it myself, pick up stray hum noticeably more easily than other cartridges, in the very same situations. Just move a hefty motor or a sizeable transformer somewhere near that cartridge and the hum rises up as clearly as you please. No two ways about it, the cartridge obviously was susceptible—is susceptible—to a good deal of hum pickup.

*But how does it work out in practice?* That is the real question.

It works out generally as GE must have predicted—pretty darned well. As I reconstruct it, this must have been the sort of canny thinking that went on *chez GE*.

1. The cartridge picks up hum, but in most situations it won't pick up enough to bother the average GE user, in all his millions.

2. The phonograph makers who install GE cartridges themselves at the factory—a major intention of such a cartridge—will be able to solve the hum problem reasonably well in advance of sale.

3. *Most home listeners are conditioned, and accept, a certain minimal hum.* Their's treasonable words, I admit, and they are



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**Frequency Response:** 15 ips  $\pm 2$ db 30 to 15,000 cps  
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 $\pm 2$ db 40 to 10,000 cps

**Flutter and Wow:** 15 ips—well below 0.15% RMS  
7½ ips—well below 0.2% RMS

**Timing Accuracy:** Within  $\pm 0.2\%$  ( $\pm 3.6$  sec. in a 30 min. recording)

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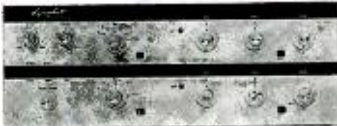
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mine, not authorized by GE. It's just what I *think* GE must have thought, in its private calculations. But the premise is valid, if unpalatable. People do accept hum, because they've always had a good bit of it around. I am astonished again and again at the hum level in various commercial phonographs—some of them right on the dealer's floor. (One was set up for demonstration in the main central office of a huge national electric company. The company engineers with me at the time hastily disclaimed responsibility; it wasn't their department.)

4. This is a really solid premise: There may be practical hum problems here and there, but technological progress in *other* components will work to GE's advantage and can be relied upon ahead of time.

GE could realistically count on steady improvement in the radiation of hum from motors and transformers, in all the minutely ingenious ways that good design engineers can apply their skill to the steady bettering of a manufactured product. Time, definitely, would favor GE.

5. And meanwhile, GE itself would work on improvements of its basic design, via experience and experiment, improvements that could further whittle down the calculated risk without tossing out the basic cartridge concept.

\*\*\*\*\*

That's it, folks, I'm all for GE, then, and in fact while I was away I hooked up my original and early GE stereo cartridge in a Glaser-Steers changer for my relatives who took over my house for some weeks. It sounded just fine and there wasn't a trace of hum to be heard. Well, almost not a trace.

### Stereotwin

Only one mild and still unsolved problem with this useful German cartridge import. The rugged stylus assembly is of the type where the stylus arm is set in a protective shell, a kind of half-circle, an open tube extending out beyond the diamond tip. This is fine insurance against the frighteningly-easy bending of the stylus that can so quickly occur in these ultra-compliant days. The fact that the whole assembly pulls out of the cartridge is additional insurance—in case the stylus is forcibly hooked into some unyielding surface such as a turntable mat. The thing just yanks out, and remains undamaged, compliance or no.

My trouble with the Stereotwin was simply in the fact that the half-tube protecting shell is small, and close to the stylus itself. There is very little leeway for play, either sidewise or vertically. Now I don't mean to imply that the stylus can't move the full width and depth of a stereo groove—of course it can. But as we all know, arm pull tends to displace a stereo stylus to one side, even with the best of care in the equipment. And, more vital, variations in the stylus force applied from above displace the point rather largely in the vertical sense. Everything's fine when the record is perfectly flat, the table precisely flat, too, the arm utterly free to move

sidewise with no measurable friction and the point pressure exactly regulated to an unchanging and rock-solid 3 or 4 grams. But how often, my friends, do we achieve this ideal in practice?

I found that my Stereotwin would produce clear musical sound at fantastically low stylus forces—but thanks to the many complications we run into the total arm-and-record assembly, at these delicate pressures it often skipped grooves, or repeated grooves. Not the cartridge's fault, basically, but—shall I say—the situation. Especially in changers.

But when I increased the stylus force a bit, the Stereotwin's stylus hit bottom (top, more correctly) and buzzed against its protecting shell.

The leeway, in my particular model, between a pressure so light as to skip grooves and so heavy as to cause stylus bottoming on the shell, was uncomfortably close. With a larger protective shell, the stylus would have more room for displacement and could take a slightly greater distortion without hitting the shell—at a greater risk of damage.

I would not want to apply my particular experience to all Stereotwin cartridges since my stylus may have been bent or loose or something else, and I understand that the newer version—the 210—has this trouble corrected. But the general principle is an interesting one, and I refer you as a comparison to the Shure stereo cartridges, which have a similar protecting half-tube construction that is, however, larger and further away from the stylus itself. Also to the Stereodyne, from Dynakit. But—the pay-off is that both of these cartridges have suffered damage under the Canby program of Rough Treatment.

The Shure M3D, my most-used cartridge, developed a permanent list to one side after a few months—and I won't try to tell you how I did it; I don't know. But list it did. However, the stylus tip did *not* hit the protecting shell at any point. And thanks to the great compliance and the traction arrangement, like an old-fashioned trolley car pole on its wire, the Shure stylus tends to straighten out in the playing and tracks more or less where it ought to, in spite of the list that shows up when you look at it. The sound, to the best of my knowledge, is unaffected.

My Stereodyne cartridge from Denmark had an even larger protective shell around the point—so large that the complaint bar in that one was bent really haywire in my first weeks of testing, to the point where I did not care to use it on my good records. My assisting engineer tried to straighten it out and broke the thing off in the process.

However, don't draw conclusions from this experience since there have been changes in this Stereodyne stylus since I got my early model. No point in judging a stylus via an assembly that is no longer in production. I'll tell you later about the rest of the Danish Stereodyne, which looks like a rocket about to take off at a tangent, and is an excellent and reasonably priced cartridge, one of the nicest I've tried. Æ



# PRODUCT PREVIEW

A look into the future at the products you will find on dealers' shelves during the coming months—some brand new, some being items introduced within the past few months, and some continuing their year-after-year of success derived from reliable performance and user satisfaction.

**W**HAT STARTED OUT to be an expanded NEW PRODUCTS section for this month completely exceeded our expectations as to size. And while the sixteen pages originally intended to include all of this material is well filled up, with more than nine columns of runover commencing on page 105, we still have not covered the entire field. The entire group of phonograph pickups and arms has been held over to provide for another section in the September issue—not, perhaps, as large as this one, but in the same general style and completeness.

On the subject of completeness, it is obvious that every product of every manufacturer cannot be pictured and described—it would more than cover all the pages of this relatively large issue and still have plenty left over. We have tried to cover some products from each manufacturer—choosing those the manufacturer himself wished to stress, or in some cases, just using our own judgement as to the most important items. In addition to the products pictured and described, several other items have been listed following many of the descriptions, which makes this section one of the most complete ever carried in a monthly magazine.

We have departed from our usual custom of not

listing prices in NEW PRODUCTS items because this PRODUCT PREVIEW is more in the nature of a catalog. You will be able to use in it planning additions to your present system or for planning a complete new system for yourself or for someone else. We believe you will find it useful as a reference all through the next year.

Since this is a catalog-type presentation, it must be remembered that the statements made about the various products are not the result of our own testing, but are the specifications as furnished by the manufacturer. And if you find some manufacturer not represented here although you know he makes products in the specific categories, you may assume either (1) that we may possibly have mislaid the material sent to us for this section, in which case it will appear next month, or (2) the manufacturer did not send us the information requested, or (3)—perish forbid—we overlooked that manufacturer completely when we sent out the requests for information.

We are sincerely grateful for the co-operation given us by all the manufacturers represented. Without their concerted help we could not have prepared this material. We trust you will find it interesting and informative throughout the year.

## AMPLIFIERS and PREAMPLIFIERS

### ACROSOUND

● *Ultra-Linear 60-Watt Power Amplifier Kit.* The Ultra-Linear II meets the performance specifications of the most demanding professional application or the most discriminating music lover. Embodying the well-known patented Ultra Linear circuit, it delivers full output with less than 1.0 intermodulation at any standard combination of test frequencies.



Harmonic distortion is less than 1.0 per cent at any frequency between 20 and 20,000 cps at output within 1.0 db of 60 watts. Frequency response is within 1.0 db from 18 to 30,000 cps at full output. Square-wave response is entirely without distortion for all practical purposes from 20 to 20,000 cps, with no overshoot or ringing. Rise time of wave is 1.5 microseconds. Damping factor is variable from 0.5 to 10. Damping control may be switched out to provide a fixed damping factor of 15. Hum is 90 db below 60 watts.

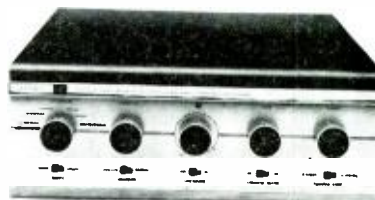
For either low- or high-power operation, the Ultra-Linear II is unexcelled. Acro Products, 369 Shure Lane, Philadelphia 28, Pa. User net price, \$79.50. Assembled, \$109.50.

Stereo 20 Self-powered 20-w ampl. Kit \$44.50.  
Stereo 20A Satellite 20-w ampl. Kit \$29.50  
Stereo 20-20 36-w stereo ampl. Kit \$69.50

### ALTEC

● *Stereo Amplifier-Preamplifier.* This latest addition to the Altec-Lansing line of high fidelity equipment, Model 353-A, is a complete amplifying system, embodying two 25-watt stereo channels which may be combined for 50-watt monophonic operation when desired. Among its features is a matrixing net-

work for "three-channel" stereo. Circuitry includes feedback-type equalization plus feedback around all tubes for minimum distortion. All low-level tubes have d.c. on heaters. Fourteen inputs include two each for magnetic cartridge, ceramic cartridge, tape head, tape recorder, tuner, microphone, and multiplex. Frequency response is 20 to 20,000 cps  $\pm$  1.0 db at 25-watts output; 10 to 30,000 cps  $\pm$  0.5 db at 10 watts. Harmonic distortion is less than 1.0 per cent. Tone controls are ganged and provide 14 db of boost or cut at 50 and 10,000 cps. Rumble filter attenuates at the



rate of 12 db/octave below 30 cps. Silicon rectifiers are used in power supply. Engineered to the professional standards of other Altec-Lansing equipment, the 353-A meets every criterion of the most discerning music lover. Altec Lansing Corporation, 1515 S. Manchester Ave., Anaheim, Calif. User net price, \$199.50.

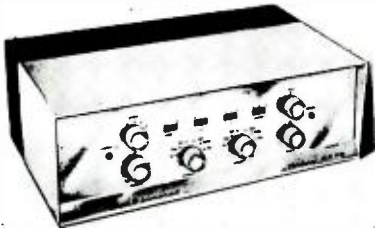
355A "Quartet" 20 w mono ampl ..... \$111.00  
350A 100 w mono ampl ..... 171.00  
440c Mono preamp ..... 147.00  
345 60 w stereo ampl ..... 270.00  
445A Stereo preamp ..... 189.00

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## ARKAY

• **Stereo Preamplifier-Amplifier Kit.** A complete audio control center which offers exceptional performance, the Arkay CS-28 matches advanced engineering with excellence of design which won the Fashion Foundation's coveted Gold Medal award. Identical

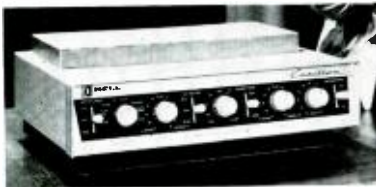


14-watt amplifiers may easily be converted to 28-watts for monophonic operation. Reverse-stereo switch interchanges channels when desired. Balance control compensates each channel for speaker systems and room acoustics. Gain control operates both channels simultaneously. All of the front-end facilities, including tone controls, are available at the dual preamp output connectors. For tape recording loudness and tone controls are bypassed by means of a panel-mounted switch. Frequency response is 20 to 20,000 cps within  $\pm 1.0$  db. Intermodulation and harmonic distortion are under 1.0 per cent at rated output. Tone controls afford 16 db boost and cut at 50 and 10,000 cps, respectively. Hum and noise level is down 70 db at low-level input. Radio Kits, Inc., 88-06 Van Wyck Expressway, Jamaica 18, N. Y. User net price, in kit form, \$64.95; fully wired, \$99.95.

FL-30	Ampl-preamp	49.95
CS-12	20w ster ampl-preamp	36.95
SPA-36	40w ster ampl	49.95

## BELL

• **Stereo Amplifier.** Developed for stereo from input to output, the Bell "Carillon" Model 6060 is conservatively rated at 30-watts output for each channel, with 60 watts of monophonic power available when needed. Frequency response is stated by the manufacturer to be 15 to 30,000 cps  $\pm 1.0$  db. Hum level is 71 db below rated output. All operating controls of the 6060 are conveniently located across the front panel. Bass controls permit 15 db rise and 18 db droop at 50 cps; treble controls afford 9 db rise and 18 db droop at



10,000 cps. Also located on the front panel are four lever-type switches which provide high- and low-frequency filter cut-off (to eliminate hiss and rumble), stereo function control, and speaker selection for stereo in more than one room. A separate balance control adjusts the volume level between two stereo speakers. Continuously-variable loudness control compensates for bass and treble at low listening levels. Dial frame is extruded aluminum, while the panel has all the lettering etched for clarity. Vinyl tan cover is set off by the perforated thermal duct which provides ventilation. Bell Sound Division, Thompson Ramo Wooldridge Inc., 555 Marion Road, Columbus 7, Ohio. User net price, \$219.95.

2212	"Pacemaker"	14w ster ampl	69.95
2221	"	20w ster ampl	99.95
2215	"	10w ampl	55.00

## BOGEN-PRESTO

• **Stereo Amplifier-Preamplifier.** The new Bogen Model DB230A is a stereophonic ampli-

fyng system providing two 30-watt channels for stereo use, or 60 watts of output for monophonic operation. Harmonic distortion is under 1.0 per cent at full output. Frequency response is 20 to 20,000 cps within 0.5 db. Featuring many engineering refinements, the DB230A has a six-position selector control for handling inputs for tape, phono cartridge, tuner, or

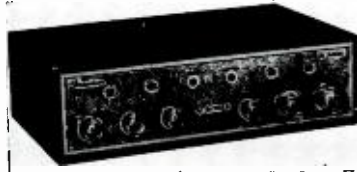


other auxiliary equipment. The unit has volume, bass and treble controls and two hi-lo filter switches. Special features are the Bogen "Speaker Phasing Switch," which eliminates the "hole-in-the-middle" effect that sometimes occurs in stereo reproduction, a loudness contour selector for levelling out frequency response at low volume, and a control for balancing the two channels plus a channel-reverse switch. Bogen-Presto Company, a Division of The Siegler Corporation, Paramus, N. J. User net price, \$189.50.

DB212 24w Stereo ampl ..... \$119.95

## DE WALD

• **Fifty-Watt Stereo Amplifier.** Although modest in cost, the Model N-2200 "Classic" embodies a complete stereo control system and two power output channels with a combined continuous-power rating of 50 watts. Included among features are separate equalization, selector, and mode controls offering the user full flexibility of operation. Tape-monitoring and tape-output jacks permit



direct tape recording with complete control of volume and tone. Individual bass and treble controls are included for each channel. Sixteen input jacks mounted in the rear of the amplifier are isolated from each other so that any or all of them may be used at any time without interference or signal loss. Output circuitry utilizes four EL-86 tubes, with resultant intermodulation being well under 1.0 per cent at full output. De Wald Radio Division of United Scientific Laboratories, Inc., 33-15 37th Ave., Long Island City, N. Y. User net price, housed in an attractive black picture-frame case with brushed-brass face plate, \$189.95.

N-1200B 30w comp ster ampl ..... \$ 99.95

## DYNAKIT

• **"Stereo 70" Power Amplifier Kit.** This amplifier kit is designed to meet the needs of the discriminating listener for a moderate-power high-performance power amplifier. Engineered for both stereophonic and monophonic operation, the Stereo 70 incorporates two 35-watt channels which can be paralleled by means of a convenient switch to provide 70 watts of single-channel output. The high power capability and low internal impedance of the amplifiers provide excellent damping for all types of high fidelity speaker systems, including the low-efficiency types, without need for individual adjustments. Frequency response is  $\pm 0.5$  db from 10 to 40,000 cps; power response—20 to 20,000 cps without exceeding 1.0 per cent distortion within 1.0 db of 35 watts. Sensitivity is 1.3 volts rms for 35 watts

output. Hum and noise level is more than 90 db below 35 watts. The use of prewired printed circuitry, detailed step-by-step instructions and pictorial diagrams, enables even the novice kit builder to construct this amplifier with complete confidence. Average construc-



tion time is about five hours. Dynaco Inc., 617 N. 41st St., Philadelphia 4, Pa. User net price, including protective cover, \$99.95.

Mk II	50 w ampl kit	69.75
Mk III	60 w ampl kit	84.95
Mk IV	40 w ampl kit	59.95
	Preamp kit, mono	34.95
	Stereo control kit	12.95
	Preamp power supply kit	8.95

## EICO

• **Low-Cost Stereo Amplifier Kit.** This new Eico amplifier brings full stereo performance to even the most budget-minded music lover. It is engineered to provide true hi-fi quality at power levels which are adequate for driving high-efficiency speakers to concert volume. The input selection, mode of operation, tone and level controls insure complete flexibility of operation. The AF-4 employs a moderate single-ganged tone control so that available gain, released by this type of control, is converted into distortion-reducing negative feed-



back. The problem of distortion, created where available gain is expended on severe bass and treble boost, is thereby avoided. The feedback level around each power amplifier is 27 db, which results in intermodulation and harmonic distortion figures, taken at average listening levels, which fall well within high-fidelity standards. Front panel controls are: input selector, mode, level, tone, and on-off. Five pairs of inputs are provided for low- and high-gain program sources. A service-selector switch permits parallel or separate operation of the power amplifiers for stereo or monophonic use, respectively. Exact engineering specifications were not available at press time. Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, N. Y. User net price, in kit form, \$38.95; factory wired, \$64.95.

HF81	ster preamp-amp	kit, \$69.95; wired, \$109.95
HF85	ster preamp	kit, \$39.95; wired, \$64.95
HF30	pwr ampl	kit, \$39.95; wired, \$62.95

## FISHER

• **Stereo Master Audio Control.** There is no more versatile preamplifier-control unit than the Fisher Model 400-CA. Capable of remote operation when used with the Fisher RK-1 remote control unit, it contains 16 input jacks for any combination of stereo or monophonic application. Four output jacks are provided and a total of 11 controls—including bass and treble controls to provide independent regulation of each channel, or ganged control of both channels—provide a shading of adjustment to satisfy the most demanding music lover. Frequency response is uniform from 20



to 25,000 cps. Distortion is less than 0.15 per cent for 2 volts output; less than 0.3 per cent for 5 volts output. Hum and noise level is down 65 db for 10-mv low-level input and 2 volts output. Crosstalk between channels is down more than 65 db. Cathode-follower re-

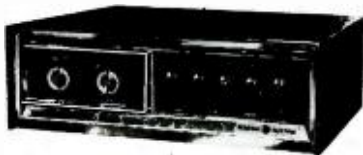


control, permits variation of input to stereo speakers. Push-button switches are used for rumble and scratch filters, to disable loudness control compensation, and for switching power on and off. Tone controls provide 15 db of boost or cut at 50 and 10,000 cps. The 28PG is fused and contains two convenience outlets. Moderate in price, it offers an unexcelled combination of fine performance at moderate cost. Precision Electronics, Inc., 9101 King St., Franklin Park, Ill.

101A	40w ster preamp-ampl	194.50
30C	preamp	59.50
400CA	ster preamp	174.50
SA-300	60w ster pwr ampl	169.50

## GENERAL ELECTRIC

● **"Stereo Classic" Amplifier.** The G-E Model MS-2000 is an integrated unit combining a high-quality stereo preamplifier with matching power amplifiers on a single compact chassis. Notwithstanding its moderate price, it leaves nothing to be desired in audio performance. Power output is 28 watts, 14 watts per channel in stereo operation. Frequency response is 20 to 20,000 cps  $\pm 0.5$  db at rated output; distortion is below 1.0 per cent. Hum and

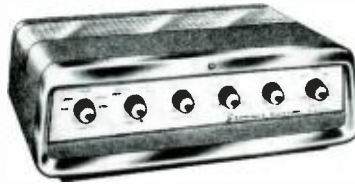


noise level is down 55 db and 73 db on low- and high-gain inputs, respectively. Channel separation is better than 40 db over the entire frequency range. Full-wave selenium rectifier reduces heat. Front panel controls include rumble filter and continuously-variable loudness contour adjustment. Tone controls are of the variable turnover Baxandall type. The MS-2000 is compact for all its power output, measuring 5½" h x 15" w x 12" d (less knobs). The cabinet is finished in leather-grain gray vinyl. Front panel is finished in darker gray with satin silver trim. General Electric Company, Audio Components Products Section, West Genesee St., Auburn, N.Y. User net price, \$129.95.

MS-4000	40 w ster ampl	\$179.95
RC-1000	Remote stereo control	14.95

## GROMMES

● **Twenty-Eight Watt Stereo Amplifier.** The new Grommes Model 28PG is complete in every respect, incorporating a full set of ganged controls, two preamplifiers, and two 14-watt power amplifiers that may be switched to 28 watts of monophonic power when not using stereo sources. Low-heat silicon rectifiers are used in the power supply. Frequency response is within  $\pm 0.5$  db from 20 to 20,000 cps. Harmonic distortion is less than 1.0 and intermodulation is under 2.0 per cent at full rated output. 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, to disable loudness control compensation, and for switching power on and off. Tone controls provide 15 db of boost or cut at 50 and 10,000 cps. The 28PG is fused and contains two convenience outlets. Moderate in price, it offers an unexcelled combination of fine performance at moderate cost. Precision Electronics, Inc., 9101 King St., Franklin Park, Ill.

## HARMAN-KARDON

● **Stereo Amplifier-Preamplifier.** The "Ballad" Model A230 is a new stereo amplifier incorporating dual preamplifiers and dual 15-watt power amplifiers on a single strikingly handsome chassis. It operates under the most conservative conditions, including self-bias of the output tubes, assuring long trouble-free performance. The power amplifiers have instantaneous recovery time, resulting in clean and faithful transient response. Among features of the Ballad are friction-clutch tone controls which adjust bass and treble separately for



each channel and lock automatically to provide the convenience of ganged operation. An exclusive speaker selector permits the operation of a third speaker as a "center channel" in a stereo system, and it also permits a remote speaker to be used monophonically at the same time. All are selectable by front panel switches. Additional features include: illuminated push-button on/off switch which permits the amplifier to be switched on or off without disturbing control settings; special tape outputs unaffected by loudness and tone controls; speaker phasing switch; contour switch; balance control; mode switch; function selector switch; rumble filter; impedance selector switch. Frequency response is stated by the manufacturer to be 15 to 70,000 cps  $\pm 1.0$  db at normal listening level. Harmonic distortion is less than 1.0 per cent at full rated output. Harman-Kardon, Inc., 520 Main St., Westbury, N. Y. User net price, less enclosure, \$109.95.

A220	"Lute" 20w ster ampl	79.95
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## HEATHKIT

● **Mono-Stereo Preamplifier Kit.** This kit is intended for those who wish to build a top-quality monophonic preamplifier now, with an eye toward converting to stereo in the future. It is available in three distinct kits. It may be purchased as Model SP-2, a complete versatile stereo preamplifier; or as Model SP-1, a high-quality monophonic preamplifier, which may be converted to stereo by means of the Model CSP-1 conversion kit. To make the conversion, no rewiring is required to the already existing monophonic channel. The conversion kit is simply wired and plugged into the SP-1 chassis, which is designed to accept the additional equipment. The control shafts plug directly through the channel A control knobs, allowing concentric operation of channel A and channel B controls. Six inputs are provided for each channel—tape, magnetic phono, microphone, and three auxiliary. Fre-

quency response is 20 to 20,000 cps  $\pm 1.0$  db; 15 to 35,000 cps  $\pm 1.5$  db. A complete complement of controls—including remote balance control on 20-ft. extension—permits every desired stereo function. Construction is greatly simplified through use of printed circuit



boards. Heath Company, Benton Harbor, Mich. User net price, SP-2 Stereo Preamplifier, \$56.95; SP-1 Monophonic Preamplifier, \$37.95; C-SP-1 Conversion Kit, \$21.95.

WA-P2	preamp, mono	\$ 19.75
EA-2	12w ampl	28.95
W-7M	55w ampl	54.95

## KNIGHT-KIT

● **Knight-Kit 40-Watt Stereo Amplifier.** Both economy and impressive performance are combined in the Knight-Kit 40-watt stereo amplifier, a complete preamplifier and power amplifier on a single chassis. Two 20-watt channels may be paralleled for monophonic operation when desired. Frequency response



is 15 to 35,000 cps  $\pm 1.0$  db at 10 watts output. In addition to offering all conventional functions for 2-channel stereo, this unit provides a unique third, or "center channel" output which permits feeding full-range program material to a center speaker for elimination of the "hole-in-the-middle" effect, or for feeding an extension speaker for monophonic listening. Bass and treble controls offer 15-db boost and droop at 20 and 20,000 cps, respectively. Among other advanced features are printed circuitry plus printed-circuit switches for ease of assembly; dual-concentric clutch-type tone controls for individual or simultaneous adjustment of the two channels, and switch-controlled Fletcher-Munson-type loudness control. Harmonic distortion is less than 0.5 per cent at rated output. Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. User net price (approximate), \$80.00.

20w stereo ampl	\$44.50
60w stereo pwr ampl	84.50
Stereo preamp	62.50

## LEAK

● **Newly-Styled "Point One" Stereo Preamp.** Impressive new styling enhances the appearance of the latest version of the well-known Leak "Point One" stereo preamplifier. Decorator-designed, the new front panel offers changeable color panels for both faceplate and knobs, enabling the user to match the decor of any room. The new escutcheon plate is interchangeable with the present one, permitting present owners the option of inex-



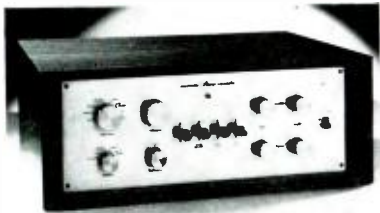


pensive conversion to the new styling. The "Point One" includes provisions for playing stereo, stereo reverse, left channel only, right channel only, and monophonically. There are five dual inputs for virtually any type of stereo or monophonic source, including microphone. Bass and treble controls permit boost and cut of 16 db at 30 and 15,000 cps, respectively. All controls are of the dual-ganged type, operative on both channels simultaneously. Distortion is less than 0.1 per cent for 1.25-volt output. A balance control allows for a great difference in sensitivity between speakers. This new unit has been expressly matched to all Leak power amplifiers. British Industries Corporation, 80 Shore Road, Port Washington, N. Y. User net price, less cabinet, \$109.50.

Ster 50 ster ampl ..... \$189.00  
Ster 20 ster ampl ..... 149.00

## MARANTZ

• **Stereo Console.** The Marantz Model 7 is a self-powered stereo preamplifier-control unit which features a high order of versatility, together with remarkable ease of operation. It will deliver unexcelled performance when used with either stereo or monophonic program sources. Typical of the quality inherent in this unit is the volume control. Especially developed for Marantz, each control is individually tested for 2-db tracking at any point of rotation down to 65 db attenuation; total range is 90 db. Separate step-type feedback tone controls with identical curves are



incorporated in each channel. The steps are in increments of 3.0 db at 50 cps and 2½ db at 10,000 cps; both controls are removed from the circuit in flat position. A full-range balance control permits complete cut-off of either speaker. Frequency response is 20 to 20,000 cps ± 0.5 db. Intermodulation and harmonic distortion are reduced to negligibility. Hum is far below thermal noise. Nine pairs of inputs and three pairs of outputs are mounted on rear panel. The Model 7, while not inexpensive, offers a measure of performance well in keeping with its price. Marantz Company, 25-14 Broadway, Long Island City 6, N. Y. User net price, less cabinet, \$249.00; cabinet, in mahogany, walnut or blond, \$24.00.

1 Mono Audio Consolelette ..... \$153.00  
2 40w pwr ampl ..... 219.00  
5 30w pwr ampl ..... 147.00  
elec x-over ..... 90.00

## McINTOSH

• **Stereo Preamplifier-Control.** Designated as the Model C-20 Stereo Compensator, this new McIntosh development is designed for the music lover who insists on the nearest possible approach to perfection. Full stereo flexibility is provided plus built-in protection for the user's investment in monophonic records. Frequency response is 20 to 20,000 cps ± 0.5 db. Distortion is under 0.2 per cent at rated output over the entire frequency range. High-level-input hum and noise level is 85 db below rated output of 2.5 volts. Six-position mode selector includes: stereo; stereo reverse; left channel on left speaker only; right channel on

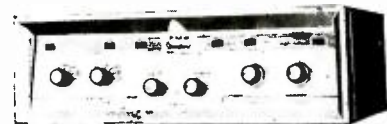


right speaker only; left channel on both speakers, and right channel on both speakers. For monophonic operation, the C-20 internally parallels and decouples a stereo phono cartridge to provide best possible reproduction from monophonic records. A 2-position high-frequency cut-off control (9 and 5 kc) is provided for suppressing hiss. Rumble filter rejects low-frequency noise. Treble control provides 13 db boost and 18 db attenuation at 20,000 cps; bass control provides 16 db boost and 20 db attenuation at 20 cps. Fletcher-Munson-type "aural compensation" control is continuously variable. The C-20 matches its impressive performance with handsome appearance. McIntosh Laboratory, Inc., 4 Chambers St., Binghamton, N.Y. User net price, \$225.00.

MC-30 30 w amplifier ..... \$143.30  
MC-60 60 w amplifier ..... 198.50

## PACO

• **Stereo Preamp-Amplifier Kit.** The Paco Model SA-40 consists of two 20-watt amplifiers, each with its own preamplifier-control system, on a single chassis. It is mounted in an attractive gold and satin black case, with satin gold panel to blend harmoniously with all decors. The amplifiers deliver a true 20 watts output per channel due largely to a well-regulated low-impedance power supply. There is no clipping even on sustained high-level passages. Distortion is kept to a minimum because of the unique main feedback circuit which eliminates phase-shifting com-



ponents. In addition to all the standard controls and switches the Model SA-40 includes: two dual phono inputs to permit the use of both record changer and manual turntable, special switching which affords selection of additional speaker systems anywhere in the home, and Balance-Right and Balance-Left test selector for a simplified aural check on the balance of two speakers for best stereo results. Frequency response measured at 1.0 watt steady-state output is 30 to 90,000 cps ± 1.0 db. Intermodulation and harmonic distortion are less than 1.0 per cent and 0.2 per cent, respectively, at full rated output. The SA-40 is supplied with step-by-step assembly instructions and giant-size wiring diagrams to ensure easy and successful assembly. PACO Electronics Company, Inc., 70-31 84th St., Glendale 27, N. Y. User net price, in kit form, \$79.95; factory wired, \$129.95.

## PILOT

• **Stereo Preamplifier-Control.** Introduced by Pilot as being "as professional as a stereo-phonetic preamplifier can be," the Model 216-A offers virtually every facility which could be desired for comprehensive audio control. Two illuminated VU meters incorporated for in-



dicating tape recording output level, or for visually balancing the channels of a stereo-phonetic music system. Exclusive Trolok tone controls permit treble and bass adjustment for each channel separately, or ganging for simultaneous adjustment. Fourteen inputs include two each for phono record changer, phono turntable, tape head, microphone, FM-AM, multiplex, tape recorder. Loudness contour control applies Fletcher-Munson compensation to both channels simultaneously. Electronic crossover feeds low frequencies to

Channel A and high frequencies to Channel B for monophonic hi-amplifier use. Frequency response is 20 to 20,000 ± 1.0 db. Harmonic distortion is 0.2 per cent below maximum sensitivity. Audio output is 1.0 volt. Hum and noise level is down 80 db. Professional in both design and performance, the 216-A will enhance the potential of any home music system. Pilot Radio Corporation, 37-04 36th St., Long Island City 1, N. Y. User net price, complete with enclosure, \$199.50.

240 30w ster preamp-ampl ..... \$129.50  
245-A 40w ster preamp-ampl ..... 199.50  
232 40w basic ster ampl ..... 89.50  
260 70w basic ster ampl ..... 139.50  
SP210 ster preamp ..... 89.50

## PRECISE

• **Stereo Amplifier-Preamplifier.** Containing two individual amplifiers and preamplifiers on a single compact chassis, the Integra Mark XXIV affords stereo users two audio channels, each with a continuous power rating of 20 watts. When desired the two channels may be combined for monophonic operation with a 40-watt power rating. Although low in cost, the Integra offers many features of higher-priced amplifiers. Frequency response is stated by the manufacturer to be flat from 18 to 20,000 cps, with harmonic distortion and intermodulation less than 0.4 per cent and 0.6 per cent, respectively, at normal listening levels. Separate bass, treble, and volume controls are supplied for each channel. A master



loudness operates on both channels simultaneously. A three-position contour switch permits adjustment to room acoustics. Channel reversal is accomplished by means of a panel-mounted slide switch. The Integra is handsomely finished with a white and gold contrasting front panel. Precise Development Corporation, 2 Neil Court, Oceanside, N.Y. User net price, \$99.95.

## SARGENT-RAYMENT

• **Stereo Preamplifier-Amplifier.** Developed for use in advanced music systems, the S-R Model 1717 meets professional standards throughout. It is a combination on a single chassis of two preamplifiers, including tone controls, with a stereo power amplifier, each channel of which is rated at 20 watts. All controls are of the dual ganged type, affording ease and accuracy of stereo tuning. A stereo balance control provides equal volume from both channels at any point in the listening room. Type 7189 tubes are used in a high-efficiency push-pull output circuit, delivering less than 1.5 per cent intermodulation and less than 0.5 per cent harmonic distortion at rated output. Bass and treble controls afford up to 15 db boost at 40 and 10,000 cps, respectively, with less than 1.0 db rise at mid-frequency. Carbon-deposited resistors are used in the preamp for minimum noise. Frequency response is within ± 1.0 db from 20 to 15,000 cps through the entire system with tone controls set flat. A separate audio output is supplied from each channel for tape recording. An 8-position selector switch con-

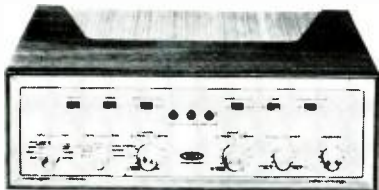


trols inputs and equalization for various types of recordings. Sargent-Raymont Company, 4926 E. 12th St., Oakland 1, Calif. User net price, including attractive metal housing, \$189.60.

SR-570 70w basic ampl	119.50
SR2000 ster preamp	163.50
SR-5100 100w ster basic ampl	183.60

## H. H. SCOTT

● **Stereo Amplifier.** The Scott Model 299 is a complete stereo amplifier-control center. It is conservatively rated at 40 watts and includes two complete channels with dual preamplifiers and dual 20-watt power sections.



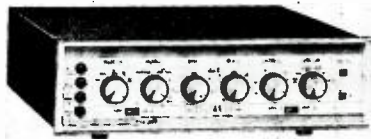
Among its advanced stereophonic features is a third-channel output for eliminating the "hole-in-the-middle" effect. Separate bass and treble controls are provided for each channel to permit compensation for differences in speaker characteristics. Low-level stereo cartridge inputs have 3.0-mv sensitivity for accommodation of pickups with very low output. Phase-reversal switch corrects for reversed phasing on improperly made tapes and recordings. In addition to its function as a stereo amplifier, the 299 can also be used as an electronic crossover. Special balancing circuit permits quick and accurate channel balance. Preamplifier tubes have d.c. on filaments to minimize hum. Frequency response of the 299 is stated by the manufacturer to be virtually flat from 20 to 30,000 cps. Intermodulation and harmonic distortion are less than 0.3 per cent and 0.8 per cent, respectively. Hum is stated to be 80 db below rated output. Technical excellence of the 299 is

matched by its flexibility of operation, containing, as it does, control for most every conceivable stereo or monophonic function. H. H. Scott, Inc., 111 Powder Mill Road, Maynard, Mass. User net price, \$199.95.

99D 22w comp ampl	\$109.95
222 24w comp ster ampl	139.95
250 40w pwr ampl	119.95
130 Ster preamp	169.95
135 Stereo-Daptor	24.95

## SHERWOOD

● **Stereo Amplifier-Preamplifier.** The new Sherwood Model S-5000 incorporates two channels with a continuous power handling capacity of 20 watts each. It permits either 20-watt-stereo, or 40-watt-monophonic operation with only one set of basic coordinated controls, yet offers every important control feature essential to both stereo and monophonic operation. These include 10 two-channel controls, stereo normal/reverse switch, phase inversion switch, and dual amplifier monophonic operation with either set of input sources. All controls normally operate both channels simultaneously. In addition, the bass and treble controls feature friction-locked shafts which allow the adjustment of each channel separately when desired. Also provided is operation of a stereo phono cartridge playing a monophonic record with vertical rumble and noise components balanced out. Frequency response of the S-5000



is 20 to 20,000 cps within  $\pm 0.5$  db. Harmonic distortion and intermodulation are 0.5 and 1.5 per cent, respectively, at full rated output. Styling and front-panel size are identical with that of other Sherwood amplifiers and the S-2000 FM-AM tuner (see *Tuners* on page 74). Sherwood Electronics Laboratories, Inc.,

4300 N. California Ave., Chicago 18, Ill. User net price, less case, \$189.50.

S-1060 60w comp ampl	149.50
S-1000II 36w comp ampl	109.50
S-4400 36w add-on basic ampl, ster preamp	159.50

## STROMBERG-CARLSON

● **Stereo Control Amplifier.** The Stromberg-Carlson Model ASR-433 is a completely versatile amplifier which can be used for stereo or monophonic reproduction, or as an electronic crossover for monophonic operation with a tweeter and woofer. Each of its two chan-



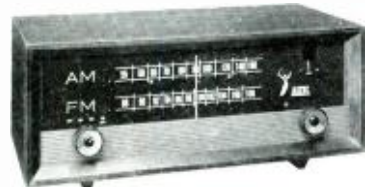
nels has a continuous power rating of 12 watts with frequency range of 20 to 20,000 cps within  $\pm 1.0$  db. Intermodulation and harmonic distortion are both under 1.0 per cent. The exclusive Stromberg-Carlson "output balance signal" permits balancing of the two channels by a signal tone. Each channel has its own set of controls—loudness/volume, bass and treble—plus a master gain control which affects both channels simultaneously. Full-frequency feedback provides minimum distortion at all frequency levels. D.c. is superimposed on all preamp filaments, bringing hum and noise level down 63 db. Matching impressive performance with distinctive appearance, Stromberg-Carlson amplifiers are designed by Joseph Federico, one of the country's leading designers. Stromberg-Carlson, Special Products Division, 1400 N. Goodman St., Rochester 3, N.Y. User net price, \$129.95.

ASR-333 24w ster ampl	\$ 99.95
ASR-444 60w ster ampl	169.95
ASR-434 ster preamp	99.95
ASR-422 40w ster pwr ampl	99.95

# TUNERS

## ALTEC

● **AM-FM Tuner.** Employing a fully shielded extra large tuning capacitor directly mounted to the chassis for perfect grounding, the carefully designed circuit layout and complete isolation between transformers and power mains in the 306A tuner reduce coupling to a point that easily exceeds FCC radiation requirements. The FM section employs a Foster-Seeley discriminator, "cascode" low-noise r.f. stage, triode low-noise mixer, a.f.c., and two limiters. AM section has three i.f. trans-

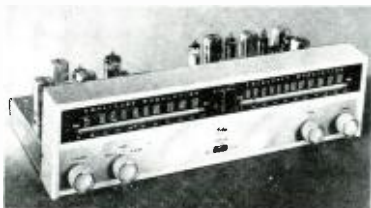


formers for flat pass band, and sensitivity is 3 microvolts on an outside antenna and 50 microvolts with the built-in Ferrite loopstick. Distortion is less than 1.5 per cent at 30 per cent modulation on AM and less than 1 per cent at 100 per cent modulation on FM. Cathode follower output. Altec Division, Ling-Altec, 1515 S. Manchester Ave., Anaheim, California. User net price, less cabinet, \$199.50.

307A FM tuner	\$96.00
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## ARKAY

● **Stereo-Binaural Tuner Kit.** The Arkay Model ST-11 is designed for simultaneous reception of FM and AM broadcasts, or for monophonic reception of either. In effect it is two distinct self-powered tuners mounted on a single chassis. Sensitivity on FM is 4.0 microvolts for 20-db quieting. Three wide-band high-gain i.f. stages and Foster-Seeley discriminator assure excellent selectivity. Image rejection is 30 db minimum. FM frequency response is 20 to 20,000 cps within 0.5 db, with distortion less than 1.0 per cent. Variable a.f.c. adds to flexibility of FM tuning. Hum level is down 65 db. AM section



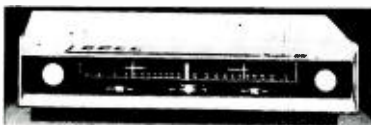
features variable-bandwidth i.f. stages, with frequency response of 20 to 8500 cps in broad-band position. Image rejection is 30 db minimum. A 10-kc. whistle filter eliminates interstation interference. Features common to both sections are adjustable gain control, flywheel tuning, and edge-lighted 0-100 logging scale. The advanced engineering features contained in the ST-11 provide the custom builder a stereo tuner of excellent sensitivity and flexibility of operation. Radio Kits, Inc., 88-06

Van Wyck Expressway, Jamaica 18, N.Y. User net price, \$49.95; fully wired, \$74.50.

AM-5 AM tuner	\$ 29.95
FM-6a FM tuner	25.75
HFT-7 FM-AM tuner	32.00
FM-8 FM tuner	39.95

## BELL

● **AM-FM Stereo Tuner.** One of the newest additions to the Bell line is the Model 3070 AM-FM stereo tuner which matches in styling the stereo amplifier of the same company. This unit features automatic frequency control, logging scale, multiplex output, and a stereo selector switch which feeds either AM or FM monophonic signal through both channels of the stereo amplifier, or feeds both simultaneously to separate channels for stereo. FM



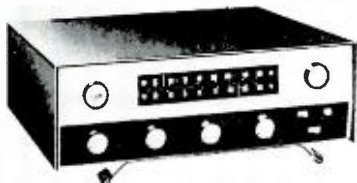
section has a sensitivity of 6 microvolts for 20 db of quieting, and image rejection is 28 db. Hum and noise are 50 db below 100 per cent modulation. The AM section furnishes a 0.1-volt output signal from a 20-microvolt input signal, while both channels give a 2.5-volt output at 100 per cent modulation at usual input signal levels. Cabinet has unusually low silhouette, being only 4½ in. high by 16 in. wide and 11½ in. deep. Bell Sound Division, Thompson Ramo Wooldridge Inc., 555 Marlon Rd., Columbus 7, Ohio. User net price, \$139.95.

2216 "Pacemaker" FM trn	\$ 69.95
2222 " " AM-FM ster trn	109.95



## BOGEN-PRESTO

● **Budget-Priced Stereo Receiver.** The Bogen-Presto "Challenger" Model RC412 is an FM-AM stereophonic receiver with a dual 6-watts-per-channel amplifier which delivers 12 watts in monophonic operation. Frequency response is 30 to 15,000 cps. Inputs are provided for magnetic and crystal phonograph



cartridges, tape recorder, and auxiliary equipment. The receiver has built-in antennas for both FM and AM, as well as a connection for outside antenna. A multiplex switch is also provided. Hum and noise level is down 58 db on FM, 48 db on AM, and 45 db on all other inputs. Distortion is 1.5 per cent on FM, 3.0 per cent on AM, and less than 1.0 per cent on phono and tape channels. Audio sensitivity is 4.0 mv for magnetic cartridge and tape operation. Dimensions are 16½" w x 12½" d x 5½" h. Bogen-Presto Company, a Division of The Siegler Corporation, Paramus, N. J. User net price, less enclosure, \$169.50; enclosure, \$8.50.

FM51 Basic FM tuner ..... \$115.00  
T661 Basic AM-FM tuner ..... 139.50  
ST662 AM-FM Stereo tuner ..... 189.50

## DE WALD

● **Stereo Tuner.** Modest price and good performance are combined in the De Wald Model N-1000-B "Ambassador" FM-AM stereo tuner. Included in the circuitry are eight tubes plus diode detector and rectifier, with four stages of i.f., including discriminator. Sensitivity is



3.0 microvolts for 20-db quieting. Frequency response is 20 to 20,000 cps and hum level is stated as being 70 db below 1.0 volt. Response of a.f.c. is +0.8 megacycles at 100 microvolts. Output jacks include AM, AM-FM monophonic, FM stereo, AM tape, FM tape, and multiplex. The tuner is cased in an attractive black picture-frame housing with brushed-brass face plate. De Wald Radio Division of United Scientific Laboratories, Inc., 35-15 37th Ave., Long Island City 1, N.Y. User net price, including cabinet, \$99.95.

## EICO

● **Wide-Range AM Tuner Kit.** The new Model HFT94 is a basic AM tuner designed primarily for high fidelity application. It matches in size and appearance the EICO HFT90 FM tuner, the two tuners making excellent companion units for stereo operation. The HFT94 offers a choice of wide bandwidth to 14,000 cps for high fidelity operation, or narrow bandwidth to 7000 cps when the objective is to receive



distant stations. A high Q filter eliminates 10-kc whistle while reducing response by no more than 3.0 db at 9000 cps. A full-wave rectifier and heavy filtering provides a stable hum-free supply. R.f. and i.f. coils are supplied pre-aligned so that no test instruments are needed for satisfactory operation of the completed kit. Additional features include slide-rule dial, flywheel tuning, auxiliary output for recording, and front-panel volume control. Image rejection is 58 db. Precision tuning is achieved by a traveling eye indicator which contracts into an "exclamation point" at the exact center of each broadcast channel. The HFT94 is also available completely wired, ready for installation. Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, N. Y. User net price, \$39.95; fully wired, \$69.95.

HFT-90 FM tuner .. kit, \$39.95; wired \$65.95  
HFT-92 AM-FM tuner kit, \$59.95; wired, \$94.95

## FISHER

● **Super-Sensitive FM Tuner.** Introduced by the manufacturer as the most sensitive FM tuner in the world, the Fisher FM-100 requires only 0.4 microvolt for 20 db quieting with a 72-ohm antenna. Frequency response is 20 to 20,000 cps ± 0.5 db, with a 60-db signal-to-noise ratio for 100-microvolt input, and distortion is less than 0.5 per cent at full modulation. The wide-band ratio detector,



using a matched pair of germanium diodes, offers completely linear and distortion-free operation entirely free of hum. Instantaneous-acting dual dynamic limiter stages are highly effective on any signal, whether strong or weak, eliminating ignition interference and other noise elements. A Multiplex Separation control is included on the front panel, plus Main and MPX channel positions on the selector switch, while power and electrical connections and space have been provided for simple plug-in installation of the Fisher MPX-20 multiplex adaptor when desired. The i.f. stages are flat-topped, with an unusually wide band for maximum fidelity and minimum distortion, plus steep skirts to eliminate adjacent and second-channel interference. Included in the circuitry of the FM-100 are a dual-triode mixer-oscillator, the Fisher Microgap cascade r.f. stage, four wide-band i.f. stages, and a wide-band ratio detector. Four controls on the FM-100 include Tuning, Selector Switch, Muting Control, and Multiplex Separation. Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, N.Y. User net price, less cabinet, \$159.50.

600 AM-FM ster trn, preamp, and 20w ampl ..... \$349.50

## GENERAL ELECTRIC

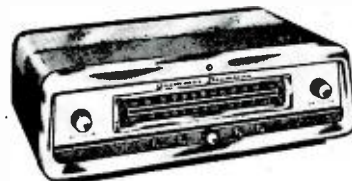
● **AM-FM Tuner.** Model FA-11 is a new unit which features high sensitivity, precision tuning, and an unusually low hum and noise level. It is equipped with an FM multiplex jack for reception of multiplexed programs when used with an adapter. FM sensitivity is 5.0 microvolts for 30 db quieting, and AM signals of



200 microvolts/meter provide a 20-db signal-to-noise ratio. FM frequency response falls within ± 2 db of flat from 20 to 15,000 cps, while AM response is down 25 db at 10 kc for interference suppression. Tuning meter indicates center-channel tuning on FM and peak of AM signal, and there is no audible drift. Circuit employs r.f. amplifier stage in both AM and FM channels for increased sensitivity and reduced noise. General Electric Company, Specialty Electronic Components Department, Utica, New York. User net price, \$129.95.

## GROMMES

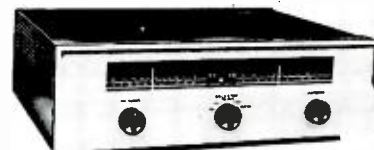
● **FM-AM Stereo Tuner.** Matching the new Grommes "Premiere" series of amplifiers in appearance, the new Model 103GT stereo tuner features FM sensitivity of better than 1.0 microvolt for 20-db quieting. The FM section has grounded-grid input, tuned cascade r.f.



stage, automatic frequency control, dual limiters, and broad-band Foster-Seely discriminator. Matched crystal diodes are used for detector. The AM section has variable i.f. selectivity, infinite-impedance detector, and 10-kc whistle filter. FM frequency response is 20 to 20,000 cps ± 0.5 db; AM response is 20 to 7500 cps ± 3.0 db in broad-band position. Tuning meter, flywheel tuning, and slide-rule scale simplify station selection. Output is provided for FM multiplex. FM distortion is reduced to negligibility at 100 per cent modulation. Push-button switches control tuning meter, AM bandwidth, a.f.c. in-out, and power off-on. Precision Electronics, Inc., 9101 King St., Franklin Park, Ill. User net price, \$201.95.

## HARMAN-KARDON

● **FM-AM Stereo Tuner.** Engineered as a companion piece to the H-K "Ballad" Model A230 stereo amplifier, the "Sonnet" Model T230 tuner incorporates separate AM and FM sections for receiving stereo broadcasts. A jack in the rear makes it readily adaptable for multiplex reception. The Sonnet employs a new low-noise front end consisting of grounded-grid cathode-fed r.f. amplifier, double-tuned overcoupled r.f. interstage, and low-noise grid-fed triode mixer, followed by



transitionally-coupled i.f. stages. It uses an Armstrong circuit with pentode limiter, wide-band Foster-Seely discriminator, and automatic frequency control. The AM circuit is a superheterodyne with a.v.c. and a built-in ferrite loopstick antenna. FM sensitivity is 3.5 microvolts for 20 db quieting; 7.0 microvolts for 30 db quieting. FM frequency response is 30 to 15,000 cps ± 0.75 db. Intermodulation is under 3.0 per cent at 100 per cent modulation. Harman-Kardon, Inc., 520 Main St., Westbury, N.Y. User net price, with enclosure, \$114.95.

T224 "Duet" AM-FM ster trn ..... \$114.95  
TA230 "Festival" AM-FM ster trn, pre-amp-ampl ..... 259.95

## HEATHKIT

● **FM-AM Stereo Tuner Kit.** Outstanding features in both circuitry and styling in the PT-1, a 16-tube deluxe FM-AM combination, include:





three circuit boards for easy construction and high stability; wired, prealigned 3-tube FM tuning unit; tuning meter; a.f.c. with on-off switch and flywheel tuning. FM and AM circuits are separate and individually tuned. Cathode-follower outputs with individual level controls are provided for both sections. Other features include variable AM bandwidth, 10-kc whistle filter, tuned-cascade FM front end, FM a.g.c. and amplified a.v.c. for AM. Unique i.f. limiter design automatically provides the number of limiting and i.f. stages required for non-flutter reception of weak or strong stations. Depending on signal strength anywhere from one to four limiters or i.f.'s are automatically provided. FM sensitivity is 2.0 microvolts for 20-db quieting. Harmonic distortion is less than 1.0 per cent. Frequency response is 20 to 20,000 cps  $\pm 2$  db on FM. A jack is provided for use of a multiplex converter without changing existing circuitry. The tuner is housed in a vinyl-clad steel cabinet finished in black with gold trim. Heath Company, Benton Harbor, Mich. User net price, \$89.95.

BC-1A AM tuner ..... \$ 26.95

## KARG

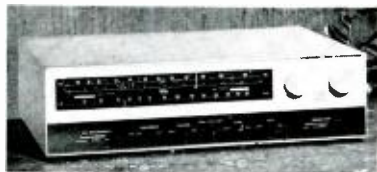
● *Twelve-Channel FM Tuner.* Although similar basically to earlier versions of the Tunematic FM tuner, the new XT series embodies a number of notable improvements. Up to 12 channels may be had in the new models, each channel individually controlled by a precise quartz crystal ground to military specifications. In effect, the Tunematic is a group of fixed-frequency tuners mounted on a single chassis. Other refinements in the newly-designed chassis include a volume control com-



bined with power switch on the front panel, and the use of silicon diodes to replace the tube rectifier with the accompanying advantages of cooler operation and indefinite life. Frequency response of the XT series is stated to be 15 to 30,000 cps  $\pm 0.5$  db from antenna to cathode-follower output. Intermodulation is 0.5 per cent maximum at 100 per cent modulation. The dial of each Tunematic is custom tailored for the area in which it is to be used. If the user moves, crystals can be exchanged to cover his new location at no extra cost. Karg Laboratories, Inc., South Norwalk, Conn. User net price, including ventilated metal cabinet, \$199.50.

## KNIGHT

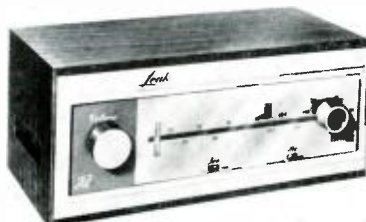
● *FM-AM Stereo Tuner.* The Knight Model KN-125 incorporates two sensitive tuners on a single compact chassis. The tuners can be used individually for AM or FM reception, or



can be used simultaneously for FM-AM stereo broadcasts. A cathode-follower multiplex output is provided for use when this form of transmission becomes available in the listener's locality. An exclusive dynamic-sideband-regulation circuit controls incoming signal to reduce distortion of very weak or over-modulated signals on FM. FM sensitivity is 2.5 microvolts for 20-db quieting; 4.0 microvolts for 30-db quieting. Circuit includes limiter-detector with dual limiters, tuned r.f. amplifier, and switched automatic frequency control. FM frequency response is 20 to 20,000 cps  $\pm 0.5$  db. AM sensitivity is 5.0 microvolts for 20 db signal-to-noise ratio, and frequency response is essentially flat from 50 to 7000 cps. Three-position variable-bandwidth i.f. is employed in the AM section. A separate cathode-ray tuning indicator is incorporated for each tuner. Handsome in appearance, the KN-125 will lend distinction to any surroundings. Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. User net price, \$139.95.

## LEAK

● *FM Tuner.* The new "Trough Line II" tuner matches in appearance the newly-styled Leak "Point One" stereo preamplifier. Sensitivity of 1.5 microvolts for 20-db quieting makes practical the reception of FM stations on



considerable distances. Cathode-follower output delivers 1.0 volt and facilitates the use of long output leads with negligible high frequency attenuation. Automatic frequency control is included in the circuitry for drift-free tuning. A magic eye assures tuning accuracy. Controls include on-off switch, a.f.c. off-on, tuning, and local-distance. Chassis dimensions are  $10\frac{1}{2}$ "w  $\times$   $7\frac{3}{4}$ "d  $\times$   $3\frac{3}{4}$ "h. British Industries Corporation, 80 Shore Road, Port Washington, N.Y. User net price, less cabinet, \$129.00.

## McINTOSH

● *FM-AM Tuner.* Developed for the connoisseur, the MR-55A tuner sets high standards in distortion-free FM-AM reception. The FM section has a sensitivity of 3.0 microvolts at 100 per cent modulation for less than 3.0 per cent total distortion, using IHFM measurement standards. Distortion-free a.f.c. is completely variable. Hum is 70 db below full signal. Capture ratio is 1.0 to 0.8. Frequency response is 20 to 20,000 cps  $\pm 3.0$  db. I.f. bandwidth is 200 kc, flat on top. Silence between stations while tuning is achieved by means of



McIntosh "Ultrasonic" muting circuit. AM section features 3-position i.f. bandwidth control, with frequency ranges to 9500, 6500, and 2000 cps. Exceptionally strong a.v.c. assures less than 4.0 db audio output change with variation in input from 10 to 100,000 microvolts. Sensitivity selector has three positions. Whistle filter has 70-db rejection at 10,000 cps. Two tuning meters are incorporated in the MR-55A, one each for FM and AM. McIntosh Laboratory, Inc., 4 Chambers St., Binghamton, N.Y. User net price, \$225.00.



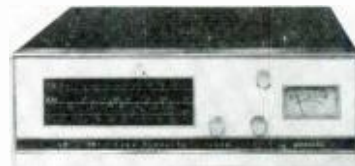
## PILOT

● *Stereo FM-AM Tuner.* The Pilot Model 680 is a deluxe unit built to professional specifications, and which offers unsurpassed reception, even in difficult fringe areas. Its independent AM and FM sections may be used individually for monophonic reception, or simultaneously for stereo broadcasts. With an external multiplex demodulator the 680 will provide FM-multiplex reception. The FM tuner section features 1-microvolt sensitivity for 20-db quieting. Freedom from drift is assured by means of a temperature-compensated oscillator. Wide-band detector (1000 kc wide) makes tuning non-critical. Interstation noise suppression (muting) is equipped with control for defeat when desired. Audio output is constant and independent of signal level. The AM section of the 680 has sensitivity of 2.0 microvolts/meter. It employs a germanium diode detector for lowest possible distortion. Featured is a high-gain pentode r.f. amplifier, two steep-skirted i.f. stages with front-panel band-width control, and a 10-kc whistle filter. A rejection trap is incorporated for i.f. interference. Separate precision tuning meters are provided for FM and AM. Built-in ferrite core antenna. Dual cathode followers permit long output cables without signal loss. The 680 is an impressive instrument in all respects. Pilot Radio Corporation, 37-06 36th St., Long Island City 1, N.Y. User net price, complete with enclosure, \$219.50.

690-A AM-FM ster tun, ster preamp .. \$289.50  
590 AM-FM ster tun, ster preamp .. 239.50

## PRECISE

● *FM-AM Tuner.* Despite its low cost, the "Perfecta" is a tuner of distinctive appearance and excellent performance. Among its features is a tuning meter which assures accuracy of station selection. Circuitry includes



a power transformer, with full-wave rectification. Output is of the cathode-follower type. Included in the circuit are two limiters, a Foster-Seeley discriminator, and a three-gang tuning capacitor. A logging scale and flywheel tuning assure precision tuning on both FM and AM. Panel-mounted function switch affords selection of phono, FM, AM, or TV. Variable a.f.c. eliminates drift effect on FM. Precise Development Corporation, 2 Neil Court, Oceanside, N. Y. User net price, less cage, \$99.95.

## SARGENT-RAYMENT

● *Stereo FM-AM Tuner.* Strictly deluxe in every respect, the SR-1000 offers every feature which could be desired in an instrument of this type. Sensitivity of 0.85 microvolts for 20-db quieting on FM is achieved by means of



advanced circuitry and use of a gold-plated frame-grid cascode tube. Minimum AM distortion is assured through use of the well-known S-R 2-tube detector system. Two independently operated tuning indicators are incorporated. FM frequency response is 18 to 22,000 cps  $\pm$  1.0 db. Distortion is less than 0.5 per cent at 100 per cent modulation. Drift is negligible after 10-sec. warmup period. The S-R loopstick, said to be the largest produced commercially, assures optimum AM signal-to-noise ratio. Variable band-width i.f. permits wide-range reception on AM, also excellent selectivity for distant stations. Whistle filter gives 65-db attenuation at 10 kc with no effect at 8.5 kc. Cathode follower outputs are used for both AM and FM. Sargent-Raymont Company, 4926 E. 12th St., Oakland 1, Calif. User net price, \$184.50.

SR-380 AM-FM tun, ster preamp .... \$199.20

### H. H. SCOTT

● **FM-AM Stereo Tuner.** The wide-range AM section of the Model 330-D tuner, plus a highly sensitive, drift-free, wide-band FM section make it an excellent choice for the reception



of AM-FM stereophonic broadcasts. FM sensitivity is 1.0 microvolt for 20-db quieting with matched 72-ohm antenna. Illuminated tuning and signal-strength meter for both FM and AM permits precision tuning of very weak stations. Automatic gain control affords low capture ratio, assuring rejection of interference practically as strong as the station being received; 80-db rejection of spurious

response from cross modulation by strong local signals makes possible the use of this tuner in any location, even close to FM transmitters. The AM section of the 330-D contains a 3-position adjustable i.f. bandwidth—wide-range, normal, and distant. A 10-kc whistle filter minimizes interstation interference. Low-impedance outputs permit installation of the tuner at any practical distance from the amplifier without signal deterioration. Separate outputs are incorporated for tape recorder and for multiplex. Notwithstanding its compactness, the 330-D is an excellent performer in every respect. H. H. Scott, Inc., 111 Powder Mill Road, Maynard, Mass. User net price, \$224.95.

310C FM tuner ..... \$174.95  
311D FM tuner ..... 124.95  
320 AM-FM tuner ..... 139.95

### SHERWOOD

● **FM-AM Tuner.** Featured in the Model S-2000 II tuner is one of the most sensitive FM circuits ever developed, permitting 20 db quieting with only 0.95 microvolt signal input; 3.6 microvolts affords a signal-to-noise ratio of 50 db. This unusual sensitivity makes FM reception practical beyond 100 miles. In addition, highly stable coil design, delayed automatic gain control, and Foster-Seeley type discriminator preceded by three limiters, assure a minimum of distortion even with modulation over 100 per cent. The AM section of the S-2000 II features a selection of either a 15-kc wide "hi-fi" bandpass or a sharply selective 5-kc bandwidth for listening to weaker stations without noise and interference. A high-Q filter traps out 10-kc inter-



station whistle while reducing audio response less than 3 db at 8 kc. A built-in ferrite-rod antenna is pivot-mounted and may be oriented for best reception of distant stations. FM frequency response is 20 to 20,000 cps within  $\pm$  0.5 db. A multiplex output jack is provided for connection to a multiplex adapter. Sherwood Electronics Laboratories, Inc., 4300 N. California Ave., Chicago 18, Ill. User net price, less case, \$145.50.

S-3000II FM trr ..... 105.50

### STROMBERG-CARLSON

● **FM-AM Tuner.** Engineered for easy, accurate tuning, the Stromberg-Carlson Model SR-440 also features high sensitivity to provide outstanding FM performance in fringe areas and to permit reception of distant AM stations. FM sensitivity is 0.9 microvolt for 20-db quieting. Wide peak-to-peak separation (550 kc), a long linear slope (350 kc) of the balanced-ratio FM detector, and low-noise golden-grid cascode front end result in high signal, low noise, and exceptionally stable output. Improved temperature-controlled circuitry eliminates drift for all practical purposes. Frequency range on FM is 20 to 20,000



cps; on AM it is 20 to 7000 in broad-bandwidth position. FM i.f. bandwidth is 200 kc; AM is 15 kc broad, 8 kc sharp. The tuner is well within FCC requirements for spurious radiation. Distinctively styled with white face plate and brushed brass escutcheon and knobs, the SR-440 matches its impressive performance with handsome appearance. Special Products Division, Stromberg-Carlson, 1400 N. Goodman St., Rochester 3, N.Y. User net price, \$159.95.

## LOUDSPEAKERS

### ACOUSTIC RESEARCH

● **Low-Cost "Acoustic-Suspension" Speaker System.** Selling for less than a hundred dollars, the AR-2 speaker system uses the AR-patented acoustic-suspension principle, in which a small enclosure is accompanied by improved rather than compromised reproduction quality. In this design the speaker (woofer) cone is mounted on very free suspensions, so compliant that they are unable to provide the elastic restoring force normally required of



them. The missing elasticity is then reintroduced by the pneumatic spring formed by the air within the cabinet. The cone literally rides on air instead of on mechanical springs. The small enclosure size is necessary for optimum performance. The AR-2 is a 3-speaker system comprising a single woofer and two 5-in. tweeters. Frequency response is more than adequate to cover the entire range of musical instruments. Horizontal dispersion is 90 deg. Dimensions of the AR-2 system are 13½" h x 11½" d x 24" l. Recommended for use with amplifiers having power output of 20 to 40

watts. Acoustic Research, Inc., 24 Thorndike St., Cambridge 41, Mass. User net price, in mahogany or birch, \$96.00; utility, unfinished pine, \$89.00; walnut or cherry, \$102.00; korina, \$111.00.

AR-1 full-range spkr system, mah ... \$185.00  
AR-1W woofer only, mah ..... 145.00  
AR-3 full-range spkr system, mah .... 216.00

### ALTEC

● **Economy Speaker System.** The Monterey Jr. is a compact moderately-priced system whose quality of reproduction equals that of some systems costing considerably more. A small ruggedly-built bass reflex enclosure houses an Altec 402A 8-in. "controlled-linear-excursion" speaker and the newly-designed 2000A direct-radiator cone tweeter. Frequency range of the Monterey Jr. is stated by the manufacturer to be 20 to 18,000 cps, and power rating is 15 watts. Impedance is 16 ohms. A single Monterey Jr. is excellent for monophonic listening, while two make an ideal medium-priced stereo system. It can be flush-mounted in a wall or ceiling, or used in a console as an integral part of a music system. Dimensions

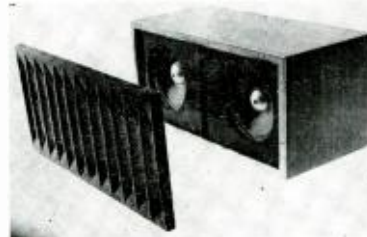


are 11½" h x 23" w x 11½" d. User net price, in walnut, blond or mahogany, \$79.50; unfinished, \$69.50.

7003 "Melodist" system ..... \$126.00  
830A "Laguna" corner spkr system .. 599.00  
832A "Corona" corner spkr system .. 399.00  
833A "Verde" spkr system ..... 309.00  
605A Duplex 15" loudspeaker ..... 177.00

### AUDAX

● **Multi-Speaker System.** Designed by George Nelson, one of the country's leading furniture and industrial designers, the new Audax speaker series brings a distinctive blend of beauty and functionalism to component high fidelity. "The idea behind the Audax speaker systems was to make them interesting, exciting furniture pieces, beautiful in appearance as well as sound," said Mr. Nelson. The Audax cabinets are finished on all four sides,



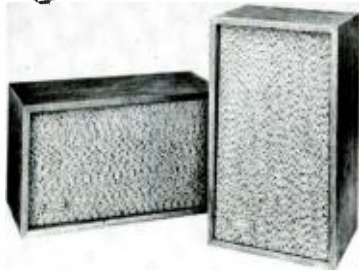
to be used as wall units or free standing. Each model has detachable legs and a new type of speaker grille, a three-dimensional "acoustical screen" which can be removed easily for cleaning. Model CA-80 contains two 8-in. extended-range speakers. Model CA-100 has



two 10-in. woofers, plus two cone tweeters. Both units are identical in external appearance. Both are intended for bookshelf placement, and also may be used as floor units. Both systems use Audax "Paraflex" speakers, a patented new design with many innovations, giving a sound quality which is smooth and natural. Audax, Inc., Division of Rex-O-Kut Company, Inc., 38-19 108th St., Corona 68, N.Y. User net price for the CA-80 is \$99.95; for the CA-100, \$139.95.

## AUDIO-TECH

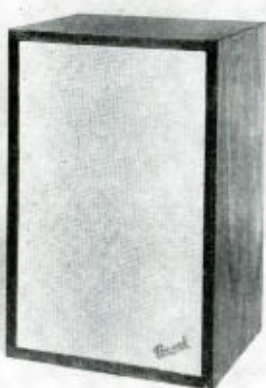
● *Wide-Range Speaker System.* Although extremely compact, the Audio-Tech Model ME12 has a frequency range of 37 to 20,000 cps.



Containing a 12-in. woofer and a 3-in. cone-type tweeter, it incorporates a special calibrated level control for high-frequency balance. Colored binding posts permit easy determination of polarity for connection in stereo music systems. The speakers are fused to prevent damage from accidental overload. Enclosures are made from selected walnut, mahogany and fruitwood, with a handsome, hand-rubbed oil finish. Audio-Tech Laboratories, 3420 Newkirk Ave., Brooklyn 3, N.Y. User net price, \$99.50.

## BOZAK

● *Small Speaker System.* The Spinnet, a new, small speaker system has been introduced by Bozak to meet the needs of listeners who have a pronounced space problem. Measuring a compact 14 1/2" h x 23 3/4" w x 11 1/2" d, it has a



naturalness of response in bass, mid-range and treble which is compatible with the larger Bozak speaker systems. The Spinnet is available in two models: the two-way B-500 system, and the three-way B-502 system. Both models utilize the same finely-constructed, integrated components found in larger Bozak systems, and upon which the Bozak "Systematic Growth" idea is based. This latter enables users to start with a modest installation, and then to "build" on it as they desire, without having to replace initial components. The Spinnet is available finished in mahogany, blond, walnut, or ebony, or unfinished for those who wish to match the cabinet to an existing decor. R. T. Bozak Sales Company, Darien, Conn. User net price B-500, \$134.50; B-502, \$209.50.



## BRADFORD

● *Compact Wide-Range Speaker Enclosure.* The Bradford enclosure, made in four sizes for 8-, 10-, 12-, and 15-in. speakers, is only two inches larger than the speaker it contains. Its construction is based on a variable-damping principle, in which speaker damping is varied automatically by a pressure relief valve in the rear of the cabinet. Operation of the valve is coordinated with cone excursion. In reality, it is an "acoustic spring" acting uniformly over the entire rear surface of the cone. Boominess and the effects of cabinet resonance are virtually eliminated. The Bradford enclosure will enable the user to realize the potential of most any speaker with which it is used. Bradford Audio Corp., 27 E. 38th St., New York 16, N.Y. Prices of the Bradford enclosure range from \$39.50 to \$69.50, depending on size and finish.

2-12 Spkr system, mah ..... \$250.00  
4-12 Spkr system, mah ..... \$25.00

## COSMOS' "AH!"

● *Electrostatic Mid-Range Speaker/Super Tweeter.* Frequency range of the "ah!" extends from 600 cps to well beyond the limits of audibility. It mates easily and quickly with any woofer or full-range speaker to provide extended high-frequency response. Two push-

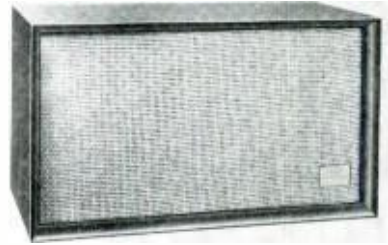


pull capacitor elements give direct radiation over a full 120-deg. arc. Polarizing voltage is supplied by a built-in fused 1000-volt power supply which consumes practically no current and may be left permanently connected to a 117-volt 60-cycle line. Crossover network is self-contained. Recommended crossover frequency is 650 to 850 cps. The "ah!" may be paralleled across any conventional woofer without additional network. Two "ah!"s may be used in conjunction with a single woofer for fine stereo reproduction. Supplied in cabinet with hand-rubbed walnut finish. Other finishes available on special order. Cosmos Industries, 31-28 Queens Blvd., Long Island City 1, N.Y.

## ELECTRO-VOICE

● *Ultra-Compact Speaker System.* Economy is preserved without any sacrifice of performance or appearance in the E-V "Esquire" Model 200. The latest addition to the broad E-V line of ultra-compact systems, it is a full 3-way system using specially designed and coordinated components. Bass is delivered from a highly-compliant 12-in. woofer with a long-throw voice coil. An 8-in. cone driver is incorporated for smooth mid-range, and the E-V Sonophase-throat-design tweeter handles the very highs. The acoustically-correct enclosure is coordinated in design with the

three drivers to provide a measure of performance which is hardly believable in a system of such compact size. The diffraction horn employed on the tweeter makes the Esquire 200 ideal for use in pairs for full-range stereophonic reproduction. Supplied in



hand-rubbed hardwood veneers, it will add distinction to even the most tasteful surroundings. Available in walnut, mahogany, or limed oak. Electro-Voice, Inc., Buchanan, Mich. User net price, \$111.00.

● *Thirty-Inch Woofer.* This is the world's first mass-produced 30-in. loudspeaker. Engineered expressly for use in the well-known E-V "Patrician" 700, the Model 30W is also highly recommended for use in any custom installation of exceptional quality. The speaker frame is a massive one-piece rigid casting which supports a true piston formation cone.



The cone in itself is revolutionary, being a one-piece molding of polystyrene foam manufactured by a newly-developed injection-forming process. The 30W is capable of reproducing bass tones in the range of 18 cps with earth-shaking reality. While these tones do not exist in pure form in commercially-recorded music, there are undertones and sub-harmonics in this area which add distinctly to realism in reproduction. Electro-Voice, Inc., Buchanan, Mich. User net price, \$139.00.

## FRAZIER

● *Compact Two-Way Speaker System.* The Monte Carlo, the newest and smallest Frazier two-way speaker system, is made to order for stereo. Measuring only 15 3/4" w x 10 3/4" h x 11 3/4" d, its size permits its use as a bookcase-type speaker, and it is the most economical of all Frazier models for starting a stereo sys-





tem. It employs a modified Helmholtz-radiator principle, and has a frequency range from below 70 to 15,000 cps. Power handling capacity is 12 watts continuous. Tweeters are mounted for right and left placement for stereo. The cabinet is equipped with two concealed plastic feet and is finished in hand-rubbed natural walnut. The Monte Carlo is shipped two to the carton, matched for stereo. International Electronics Corporation, 2649 Brenner Drive, Dallas 20, Tex. User net price, the pair, \$99.50.

Cortez 2-way spkr sys ..... \$125.00  
 Scotsman 2-way spkr sys ..... 59.50  
 Del Mar 2 spkr sys ..... 79.50

## GENERAL ELECTRIC

● *G-E Two-Way Speaker System.* Engineered for high-quality sound reproduction in a limited space, the Model G-501 is a new, compact speaker system announced only recently by General Electric's audio components section. Termed a "stereo-compact" system, the G-501 will deliver excellent audio performance, yet is only 22" w x 13" h x 9" d, true bookshelf dimensions. The new unit is based on GE's extended-bass design, and has a woofer, tweeter, and electrical crossover network all housed in a dramatically styled enclosure. The G-501 presents a departure from previous G-E speaker systems, blending rich wood finishes, new grill patterns, and greater use of metal trim. User net price, \$85.00.



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## GOODMANS

● *Four-Way Speaker System.* Built to a standard of high quality without compromise, the new Goodmans "Tetraxiom" is a unitized 4-way speaker featuring the "Rigidflex" cone, a flexible free-floating cone rim and rigid cone center to provide pure piston action. The Tetraxioms have high power capacity and smooth response from 20 to 20,000 cps, with usable response to 35,000 cps, according to the manufacturer. They are composed of four independent, concentrically-placed radiators, each of which is designed for maximum performance and efficiency within its portion of the spectrum. In addition to the Rigidflex woofer, the Tetraxiom contains a rear-driven "Midax" mid-range radiator, and two pressure-driven horn-loaded high-frequency "Trebax" tweeters which are angled to the polar axis for wide dispersion of the highs. Because of the massive nature of these speakers, and the need for absolute rigidity, all structural

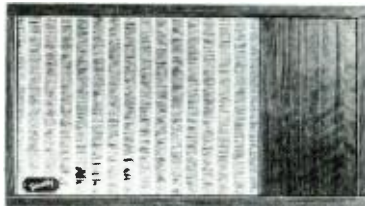


members are heavy castings. Manufactured in England, Goodmans speakers are distributed in the United States by Rockbar Corporation, Manaroneck, N.Y. User net price, Model 575 with 50-watt power handling capacity, \$232.50; Model 355, same but with 40-watt power handling capacity, \$196.50.

G15 15" 3-way spkr ..... \$147.00  
 755 15" woofer ..... 78.00  
 H750 "Midax" mid-range driver ..... 58.50

## HARTLEY

● *Compact Full-Range Speaker System.* The Hartley "Capri" comprises a full-range full-size speaker mounted in a handsome natural wood cabinet which measures 24" w x 13 1/2" h x 12" d. The grill is made of bamboo, adding a



note of distinction to the appearance. The driver has a "polymerized" cone developed by Hartley engineers for rigidity and extreme lightness. Audible response extends from 30 to beyond 16,000 cps. The Capri cabinet is filled with 35 linear feet of absorbent material to form in effect a "tunnel" 10 feet long. Hartley Products Company, Inc., 521 E. 162nd St., New York 51, N.Y. User net price, \$120.00.

217 full-range spkr ..... \$ 72.50  
 217-Duo enclosure ..... 146.00

## ISOPHON

● *Three-Channel Four-Speaker System.* Made in Western Germany by a foremost manufacturer of speakers and speaker systems, the Isophon 111 is a superb instrument utilizing a woofer, a mid-range compression type driver, and two tweeters. Matched through a universal transformer and special divider network, this combination assures utmost compensation and tonal balance at all intensity levels and uniformity of response over the frequency range of 30 to 17,000 cps. The

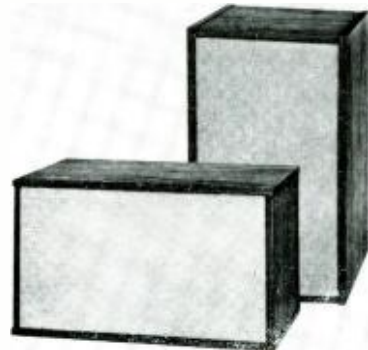


handsome hand-crafted cabinet is designed on the distributed-port principle. The 25-watt woofer has a frequency range of 30 to 8000 cps. The mid-range unit covers 1000 to 10,000 cps, while the tweeters extend from 4000 to 17,000 cps. Enclosures are available in either light Isophon Arizona finish or in dark English mahogany. Isophon Speaker Division, Arnold Ceramics, Inc., 1 E. 57th St., New York 22, N.Y. User net price, \$295.00.

IV 3-way, 4 spkr sys ..... \$169.50  
 P38 15" woofer ..... 102.50  
 P37 12" woofer ..... 49.45  
 P16 6" mid-range spkr ..... 8.15  
 P6 2 1/2" tweeter ..... 7.15

## JANSZEN

● *Wide-Range Speaker System.* The Z-400, an inexpensive wide-range speaker system, marks the first time that the well-known JansZen electrostatic tweeter has been available in a compact, shelf-mounted enclosure. In the Z-400 the JansZen is acoustically paired with the Model 350 11-in. dynamic woofer. The high-compliance cone of the 350 is specially treated to provide low-frequency reproduction which perfectly complements the JansZen tweeter. The Z-400 is stated to cover the range from 30 to beyond 30,000 cps with exceptional uniformity and low distortion. Tweeter and woofer are integrally mounted in a totally-enclosed Fibreglas-filled enclosure which may be placed vertically or horizontally as desired. A built-in power supply and high-pass filter furnish power for the two push-pull electrostatic elements, and eliminate the



need for external crossover networks and attenuators. The Z-400 measures 15" h x 26" w x 13 1/2" d, and is available in walnut, mahogany and birch finishes. Neshaminy Electronic Corporation, Neshaminy, Pa. User net price, \$134.50.

## JENSEN

● *"Satellite" Stereo Speaker System.* The new Jensen "Galaxy II" speaker system achieves wide panoramic stereo sound with two tiny satellites and a single small bookshelf-size unit. The latter, which is called the "bass center" speaker, may be placed on floor or shelf wherever convenience and decor dictate. Finish on all four sides allows vertical or horizontal positioning. The Jensen "Flexair" high-compliance woofer has unusually low resonance and is capable of total motion of 5/8 in., providing clean bass as low as 36 cps. The small satellite units handle midrange and high frequencies. Their placement is not critical so long as they are placed to the left and right of the center unit. They may be spaced as much as 20 feet apart and still provide stereo sound with excellent spacial center-fill. The Galaxy II system provides the equivalent of two complete 3-way speaker systems with the added feature of a "derived third channel" for eliminating the "hole-in-the-middle" effect. The Flexair woofer is driven by two voice coils, one for each channel of the stereo system. Frequency range of the complete system is 36 to 14,000 cps and power rating 25 watts. Jensen Manufacturing Company, 6601 S. Laramie Ave., Chicago 38, Ill. User net price, in



walnut, tawny ash or mahogany, \$169.00; the same assembly is available unfinished in kit form, \$92.50.

- SS-100 Stereo-Director 3-way system .. \$179.95
- DS-100 Dual Stereo 3-way system .... 369.50
- CN-100 12" 3-way system ..... 149.50
- P12-NF 12" Flexair woofer, low res .. 42.00

### KLH

● *Model Seven Speaker System.* This is the newest in the KLH line of integrated speaker systems. Enclosed in a sealed cabinet matched to their acoustic requirements are a 12-in. acoustic-suspension woofer and two newly-



designed director-radiator tweeters. A built-in L-C crossover network contains a 3-position switch for increasing or decreasing high-frequency level by 3.0 db. Enclosure volume is 2.6 cu. ft. Full-range frequency response of the Model Seven permits reproduction of the entire musical spectrum with a degree of realism which is unsurpassed. Power handling capacity is 75 watts of program material. Impedance is 8 ohms. Dimensions are 26 1/4" h x 21 1/2" w x 11 1/2" d. KLH Research and Development Corporation, 30 Cross St., Cambridge 39, Mass. User net price, walnut and oiled-walnut finish, \$203.00; unfinished walnut, \$198.00; mahogany and korina, \$196.00; unfinished birch, \$189.00.

- FOUR 2-way spkr sys, mah ..... \$209.00
- SIX 2-way spkr sys, mah ..... 119.00

### KINGDOM LORENZ

● *Wide-Range 12-in. Speaker.* Although modestly priced, the Kingdom Lorenz Model S-1288 offers no compromise in impressive performance. When properly housed it has a



frequency range of 18 to 15,000 cps because of dual-cone construction. Fully tropicalized for operation in any climate, it is built on a non-resonant cast-aluminum girder-constructed frame. Twin voice coils have impedance of 4, 8, or 16 ohms; one coil may be connected to each of two stereo amplifiers to provide a common woofer for the two channels. Magnet assembly weight is 61.5 oz. Power rating is 30 watts peak. Kingdom Products, Ltd., 514 Broadway, New York 12, N.Y. User net price, \$44.50.

- Omega-1 sys w/12" woofer, 2 tw ... \$109.50
- Kal Audette sys w/8" spkr, tw .... 49.50
- Audette Sr. sys w/8" woofer, tw .... 69.50
- S888 8" wide-range spkr ..... 21.50

AUDIO • AUGUST, 1959

### LAFAYETTE

● *Bookshelf Speaker Enclosure.* This cabinet is engineered to obtain optimum performance from any 12-in. wide-range speaker or 12-in. woofer-tweeter combination with no loss in speaker efficiency. Although the design is basically that of the family of "reflexed" or



"ported" enclosures, there are two unique departures. These are an elliptical port and a triangular-shaped diffracting ring mounted on the front of the baffle board. These features serve to broaden the frequency response, improve transient response, and create a "lens" effect, changing relative particle velocities and, consequently, phase relationships so as to produce a smooth transition from front to rear radiation. Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N.Y. User net price, \$32.50.

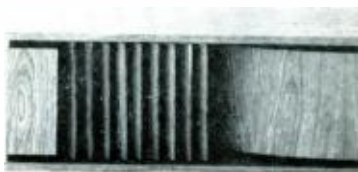
### JAMES B. LANSING

● *"Linear Efficiency" Speakers.* The Lansing Model LES is a remarkable new full-range transducer of unique design. Engineered specifically for small enclosures or infinite baffle mounting, the performance of the LES in an enclosure of only 1 cu. ft. is outstanding. Smallest of the new JBL "Linear Efficiency" components, the LES delivers full bass by means of its exceptionally long linear



travel. It will produce high sound intensity in a large room when driven by only 1.0 watt of amplifier power. Voice-coil diameter is 2-in. and free-air cone resonance is 37 cps. Power handling capacity is 20 watts continuous. For excellence of performance in a compact enclosure, the LES is unsurpassed. James B. Lansing Sound, Inc., 3249 Casitas Ave., Los Angeles 39, Calif. User net price, \$57.00.

● *"Minigon" Loudspeaker Housing.* One of several types of cabinets designed to match the Linear Efficiency components, the JBL-Ranger Minigon serves as an ideal unit for monophonic reproduction, and when placed end-to-end as a pair brings the principle of the well-known JBL-Ranger Paragon down to a



size suitable for the average living room. The Paragon measures 8' 10" in length; the smaller Metregon—a similar type of cabinet—is 6' 2"; and two Minigons measure 5' 4" in length, with a height of 12 1/2" and a depth of 15 1/2". Two styles are available, louvered (as shown) or with grille cloth. Both are designed to accommodate the Linear Efficiency speakers, with either the 8" model being used alone, or with a 10" cone (LE10) used in conjunction with an LE30 high-frequency driver and an LX3 dividing network—a system designated S-5. James B. Lansing Sound, Inc., 3249 Casitas Ave., Los Angeles 39, Calif. User net prices: Minigon enclosure alone, \$120.00; with LES speaker installed, (D4GLE8) \$177.00; with S5 system installed (D4GS5), \$243.00.

- LE10 10-in. l.f. driver ..... \$52.80
- LE30 High-frequency driver ..... 52.80
- LX3 Dividing network ..... 17.40

### NORELCO

● *Speaker Series.* Illustrated is Model AD-5277M, the most powerful in the new T-7 series of twin-cone speakers manufactured by Philips of The Netherlands, and featuring Ticonal 7, a high-coercivity alloy which provides the highest possible concentration of flux densities in the voice-coil air gap. Weight for weight, Ticonal 7 is about 30 per cent more powerful than any of the conventional magnet materials used in speaker construction. Voice-coil impedance of the new T-7 speakers is held constant throughout the



entire frequency range by means of a copper ring fitted into the air gap. The ring acts as a shorted turn which induces a current opposite in polarity to that flowing through the voice coil, which reduces that current, thereby lowering the impedance to its proper level. The resonant frequency of the T-7 speakers is very low, resulting in an extremely straight response curve in the bass region. In addition to the cone for low and middle notes, the speakers are equipped with a high-note cone which extends the upper frequency range. Model AD-5277M is a 12-in. speaker with a frequency range of 35 to 18,000 cps and 20-watt continuous power handling capacity when properly housed. Cone resonance is 35 cps. High Fidelity Products Division, North American Philips Company, Inc., Hicksville, N. Y. User net price, \$72.50.

- 1 Integrated spkr sys ..... \$150-160
- 2 Encl for 8" spkrs ..... 50-60
- 3 Encl for 8" spkrs ..... 31-35

### RJ

● *RJ/Wharfedale Speaker System.* Combining the RJ/8 enclosure with the Wharfedale Super 8/FS/AL speaker, this compact assembly is



ideally suited for stereo music systems. The RJ enclosure, when it was introduced six years ago, established an entire class of products. The RJ is distinguished from all other small-size speaker enclosures by a unique internal design, which is covered by two U.S.



## DUAL

● *Deluxe Changer-Turntable.* The United Audio DUAL-1006 is a precision-built machine in all respects. It will track and operate automatically with stylus force as low as 1.5 grams. Operating at all four standard speeds, it incorporates a motor of unusually high



power, assuring constancy of speed under any normal load condition. Field coils are tropicalized, and thorough shielding prevents hum. The lightweight tone arm is of one-piece construction and is equipped to accommodate interchangeable cartridges by means of a locking-key snap-in arrangement. Direct set of ball bearings in both axes insures freedom of lateral and vertical motion. Finger-tip stylus-force adjustment is mounted directly on the tone arm assembly. Patented roller-feeler guide in the tone-arm head permits the 1006 to operate automatically and intermix, regardless of record size. Fast change-cycle time is constant irrespective of operating speed. A stereo-mono switch introduces a phase-canceling feedback circuit to remove vertical signal when stereo cartridge is used to play monophonic records. Notwithstanding its many features, the DUAL 1006 is simple to operate, only three push buttons being used to govern start, stop, reject, and repeat functions. A muting switch assures silence during changing cycle. United Audio Products, 202 E. 19th St., New York 3, N. Y. User net price, \$69.95.

## GARRARD

● *Model RC88 Record Changer.* The precision watch-like construction of this 4-speed automatic and manual record player suits it for association with the finest of high-fidelity components. Rumble is so low that it approaches the minimum standards for in a professional turntable. All levers are machined to close tolerances and are fully adjustable; easy and inexpensive to service. Heavy steel table minimizes wow and reduces possibility of hum pickup when using magnetic cartridge. A 4-pole shaded "Induction-surge" motor further reduces the chance of hum pickup and assures constancy of speed with vibration eliminated for all practical purposes. Interchangeable plug-in pickup shells accommodate all standard cartridges. Stylus pressure adjustment is easily accessible from top side of mounting board. Manual play, with tone arm disengaged from changer mechanism, is accomplished by



means of a switch; arm returns to rest after each playing. Muting switch eliminates noise through speaker during changing cycle. An aluminum true-tangent tone arm provides rigidity, low resonance, low mass, and light weight. The RC88 is an excellent changer, worthy in all respects of its reputation. Garrard Sales Corporation, 80 Shore Road, Port Washington, N. Y. User net price, less cartridge but with two universal plug-in shells, \$54.50.

## GLASER-STEERS

● *Stereo Record Changer.* The GS Seventy-Seven is precision-engineered, completely automatic in operation, and offers new features and refinements which enhance the enjoyment of stereo records, at the same time allowing enjoyment of monophonic records to the utmost. Stylus force is variable over a wide range with easily accessible vernier adjustment. Variation of stylus force between first and last record on a stack is less than 0.9 gram. The damped, acoustically isolated tone arm is not resonant within the audio



range, and moves both laterally and vertically on pin-point bearings. Rumble, wow, and flutter have been reduced to insignificance by improved motor design. As in earlier Seventy Seven models, the turntable pauses during a change cycle, and resumes motion only after the stylus has been lowered to the next record, to reduce stylus and record-surface wear. The idler disengages automatically in "off" position to prevent wow caused by flat spots. A dual-channel muting switch and R-C network maintain silence for both stereo channels during record change and at shut-off. Glaser-Steers Corporation, 155 Oraton St., Newark, N. J. User net price, less cartridge, with two cartridge shells, \$59.50.

GSC cover for GS-77 ..... 9.75

## LESA

● *Four-Speed Record Changer.* Fully automatic, the new Lesa Model CD2/21 record changer has only two controls for all operating cycles, speed selection, start, stop, reject. Up to eight records of any size may be played with automatic intermix. For manual operation, the record balance is simply moved to its side position. When operated manually, the tone arm is returned to rest automatically after each record. A built-in click suppressor



eliminates switching noises by means of an R-C network. A 4-pole, carefully balanced, heavy-duty motor drives the CD2/21's turntable which has an exceptionally high moment of inertia. The tone-arm mechanism is jam-proof, the arm capable of being moved or handled at any time without damage to the mechanism. The record changing cycle time of 6 seconds is the same for all record sizes and speeds. Pre-wired for both monophonic and stereo operation, the Lesa changer is equipped with a universal plug-in shell which accommodates all standard cartridges. Electrophone & Parts Corporation, 530 Canal St., New York 13, N. Y. User net price, \$39.95.

4V3/11 4-sp man rec player ..... \$ 23.25

## MIRACORD

● *Automatic Record Changer.* Equally suitable for stereo or monophonic application, the new Miracord Model XS-200 is an automatic turntable when its manual spindle is in position, and a fully automatic intermixing changer when the Miracord "Magic Wand"



spindle is used. Irrespective of whether it is used as a single-record player or as a changer, the unit is push-button controlled with no need for ever touching the tone arm. Every function—Stop, Repeat, Filter, Pause, Start—is controlled by push buttons. The Jam-proof arm returns to rest after each record. A 4½-lb. cast turntable assures constant speed with minimum flutter and wow. Hum is reduced to negligibility regardless of the type of cartridge employed. A 4-speed player, the XS-200 is equipped with a heavy-duty 4-pole motor which is spring-suspended to minimize vibration. All adjustments can be made without tools. Precision-built by ELAC in Western Germany, Miracord products are distributed exclusively in the United States by Audio-gersh Corporation, 514 Broadway, New York 12, N. Y. User net price, less cartridge, \$67.50.

XMS-210 man player w/4-pole motor \$ 47.50

## THORENS

● *Record Changer.* The Thorens Model CD-43NS combines speed accuracy, silence, and a unique combination of operating features. It is wired for stereo. A three-speed machine, it is equipped with a "fine-tuning" knob for exact pitch adjustment. Incorporated is a



pause and reject control permitting immediate record reject plus adjustable pauses between records. The machine plays 12-, 10-, and 7-in. records, automatically intermixing 12- and 10-in. records when desired. Control is included for manual operation. A rugged 4-pole direct-drive motor is equipped with mechanical filter to reduce rumble content. The changer automatically shuts off after the last record in a stack has been played. Operates on 50- or 60-cycle a.c., any voltage from 100 to 250 volts. Thorens, New Hyde Park, N. Y. User net price, \$79.95.

TD-184 4-sp semi auto player ..... 75.00  
TD-134 4-sp manual player ..... \$ 59.95

LOOK FOR THIS SECTION  
NEXT MONTH

PHONO PICKUPS AND ARMS,  
Miscellaneous Accessories



# PHONO TURNTABLES

## ARGONNE

● *Hysteresis Turntable.* Employing a true hysteresis motor, this new single-speed turntable will maintain a constant 33 $\frac{1}{3}$ -rpm speed irrespective of normal load or line-voltage fluctuations. The 12-in. 4 $\frac{1}{2}$ -lb. die-cast rim-weighted aluminum table turns on a



precision ball bearing and is engaged by means of an oversize heavy-duty idler wheel. Wow and flutter components are less than 0.2 per cent, and signal-to-noise ratio is better than 45 db. The unit is supplied with a heavy rubber turntable mat and mounting template. Dimensions are 13 $\frac{3}{4}$ " x 14 $\frac{1}{4}$ " x 6 $\frac{1}{4}$ ". Argonne Electronics Mfg. Corp., 165-11 South Road, Jamaica 33, N. Y.

## CONNOISSEUR

● *Transcription Turntable.* Built throughout to professional standards, the Connoisseur Type B turntable is a three-speed machine suitable for playing both monophonic and stereo recordings. The full 12-in. table is lathe-turned and manufactured of non-ferrous material. Underneath the table a large stroboscope disc is fitted, this being viewed through a reflecting mirror with a built-in light source. Speed change is arranged mechanically and



permits a four per cent variation on all operating speeds. All revolving shafts are precision ground and lapped to mirror finish. Bearings are made adjustable so that full servicing can be performed throughout the machine's life. The synchronous motor is dynamically balanced and resiliently mounted, making it virtually vibrationless. Rumble is stated to be down 50 db, and wow is less than 0.15 per cent at rated speed. Manufactured by A. R. Sugden and Company of Brighouse, Yorkshire, Eng., the Connoisseur Type B turntable is distributed exclusively in the United States by Ercona Corporation, 16 W. 46th St., New York 36, N. Y. User net price, \$119.50.

## GARRARD

● *Deluxe Manual Record Player.* The Garrard Model 4HF constitutes a 12-in. turntable complete with transcription-type arm mounted on a single unit plate. It is fully wired for stereo or monophonic operation. Although modest in price, the 4HF affords most of the features usually expected only 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. Garrard Sales Corporation, 80 Shore Road, Port Washington, N. Y. User net price, \$59.50.

## GRAY

● *Precision-Built Turntable.* Developed to defeat the rumble problem which came with the introduction of stereo records, the Gray 33-H incorporates an unusual bearing-shaft assembly which reduces vertical motion to negligibility. Wow and flutter are well within NARTB specifications for professional equipment. A unique motor suspension virtually



eliminates vibration. A single-speed (33 $\frac{1}{3}$  rpm) machine, the 33-H is driven by a hysteresis synchronous motor through a stretch belt drive which further reduces vibration caused by mechanical coupling. Gray Manufacturing Company, Inc., High Fidelity Division, 16 Arbor St., Hartford, Conn. User net price, \$79.95. The Gray HSK-33 turntable kit contains the same engineering features as the 33-H except for smaller mounting plate. Assembly time is 25 minutes. User net price, \$49.50.

## PICKERING

● *"Gyropoise" Turntable.* Engineered specifically for microgroove records—both monophonic and stereophonic—the Gyropoise 800 Stereotable is a single-speed machine operating at 33 $\frac{1}{3}$  rpm. It embodies a unique method of magnetic suspension, on which patents are pending, which eliminates vertical rumble to the point that it becomes inconsequential in the playing of stereo records. Vertical period of spring suspension is below 5 cps; compound vertical rumble attenuation is 12 db/octave below resonance; noise is 65 db below reference level; speed accuracy is  $\pm 0.2$  per cent total variation. Pickering & Company, Inc., Plainview, N. Y. User net price, chassis only, \$59.95. Model 800CB, complete base, in mahogany, walnut or blond, \$15.00.



## REK-O-KUT

● *Hysteresis-Motor Turntable Kit.* Meeting professional standards throughout, the Model K-33-H turntable kit can be assembled in 30 minutes or less, using only simple tools. A single-speed unit (33 $\frac{1}{3}$  rpm), it features a high-efficiency hysteresis synchronous motor



built to Rek-O-Kut's exacting specifications. Noise level is 52 below average recording level. The crown-spindle belt drive uses a custom-made endless-woven fabric belt with thickness held to  $\pm 0.001$  in. An adjustment is supplied for belt tension. A built-in strobe disc permits constant speed check. The solid cast-aluminum turntable is lathe-turned, and tapered for easy disc handling. The entire assembly is finished in silver-tone aluminum. Where economy must be observed, the K-33-H presents an ideal means of possessing a high quality turntable at modest cost. Rek-O-Kut Company, Inc., 38-19 108th St., Corona 68, N. Y. User net price, \$49.95.

N-33H	33 1/3 w/hys sync motor	...	\$ 69.95
K-33	33 1/3 w/4-pole motor (kit)	...	39.95
B-12H	3-sp w/hys sync motor	.....	129.95
B-12	3-sp w/4-pole motor	.....	84.95

## H. H. SCOTT

● *Stroboscopic Turntable.* Developed primarily to meet the demanding requirements of stereo, the Type 710-A turntable employs a radically new design which isolates the table proper from all extraneous mechanical vibration. It features push-button selection of 33 $\frac{1}{3}$ -, 45-, or 78-rpm operating speed. Each speed has its own vernier adjustment and may be varied



$\pm 5.0$  per cent to match pitch of accompanying musical instruments. A built-in expanded-scale optical stroboscope permits exact speed adjustment even while a record is being played. Motor rumble is more than 60 db below recording level, and wow and flutter are less than 0.1 per cent of rated speed. Precision nylon helical drive gear and steel worm are housed in permanently oil-filled transmission. A special clutch permits cueing. H. H. Scott, Inc., 111 Powder Mill Road, Maynard, Mass. User net price, \$129.95.

## THORENS

● *Transcription Turntable.* Engineered for the finest music systems, the Thorens Model TD-124 is a four-speed machine featuring a full 12-inch, 11 $\frac{1}{2}$ -pound table for lowest wow and flutter. The main table is made of cast



iron to provide shielding against hum pickup. A cover table made of aluminum, plus an attractive rubber mat, mitigates the attraction of magnetic pickups. Precision-machined, the Thorens Roto-Drive is adjustable  $\pm 3.0$  per cent for exact musical pitch. A built-in illuminated strobe allows setting to exact speed while record is playing. Easy levelling is accomplished by means of a built-in level-bubble

and easily accessible levelling screws. The precision 4-pole motor is equipped with a compliant belt-plus-idler arrangement which provides excellent motor vibration isolation. The TD-124 operates on 50- or 60-cycle a.c. at any voltage from 100 to 250 volts. Thorens, New Hyde Park, N. Y. User net price, \$99.75.  
TDK-101 33 1/3 rpm kit ..... 47.50

## WEATHERS

● **Lightweight Turntable.** Engineered especially for modern phonograph pickups having wide-range response and low tracking force, this turntable is manufactured of light aluminum and is suspended on a bearing assembly of unique design to offer a minimum of friction. The table is driven by a 12-pole synchronous motor of very small size but of adequate torque to drive the machine at exact speed regardless of line-voltage variation or normal variations in load. Noise level is 25 db less than the noise recorded on high quality phonograph records. Rumble and



acoustic feedback are eliminated for all practical purposes. The table is a single-speed 33 1/3-rpm machine, however additional speeds may be obtained by means of the Weathers Type P-620 Electronic Speed Control which has been designed for broadcast station use. Rumble is down 70 db, flutter is 0.1 per cent, and wow is 0.15 per cent. Weathers Industries, 66 E. Gloucester Pike, Barrington, N. J. User net price, ML-1 Turntable, \$59.95.

KG01 33 1/3 rpm rec player ..... \$111.75  
KL-1 Same as ML-1 in kit ..... 34.50

# TAPE EQUIPMENT

## AMERICAN CONCERTONE

● **Professional Stereo Tape Recorder.** A machine of advanced design, the Concertone Mark VII records and plays back 2-track stereo and monophonic tapes; the Mark VII-F in addition will play back 4-track stereo and monophonic tapes. Featured in the Mark VII series is a direct-drive capstan motor and 4-pole induction-type reeling motors. Manu-



facturing tolerances are stated by the manufacturer to be within two millionths of an inch. Push-button controls are solenoid-operated. Automatic reel-end cut-off switch prevents tape runaway. Self-energizing brakes assure smooth operation without tape stretch. Dual inputs are supplied for microphones and auxiliary devices. Four separate level controls and master gain control permit mixing of all inputs. Frequency response is 30 to 17,000 cps  $\pm 2.0$  db at 7 1/2 ips. All standard reel sizes up to 10 1/2-in. can be accommodated. Lightweight for easy portability, the Mark VII weighs only 39 lbs. in portable carrying case, including record and playback preamplifiers. American Electronics, Inc., Audio Division, 9449 W. Jefferson Blvd., Culver City, Calif. User net price, Mark VII in portable carrying case, \$940.00; Mark VII-F, \$895.00.

Mk. X-3 Bdcst Rcdr, Ster rec/pb ... \$1050.00  
X-1 Bdcst Rcdr, 1/2 tr, mono rec/pb 965.00  
270 Spkr/amplifier, in case ..... 188.00

## AMPEX

● **Home Tape Recorder.** Although it is classified primarily as a home-type instrument, the Ampex Model 960 meets professional recording standards throughout. It is a highly versatile stereo machine capable of almost any desired mode of operation. Capable of recording and playing back half-track monophonic tape and two-track stereo tape, it will also play back four-track tape when desired. The 960 will record a frequency range of 30 to 20,000 cps with distortion reduced to negligibility at 7 1/2 ips operating speed; fre-

quency range at 3 3/4 ips is 30 to 15,000 cps. Its precision-engineered timing accuracy is such that it offers perfection of pitch held to tolerances of one-third of a half-tone. Flutter and wow content is under 0.2 per cent rms at 7 1/2 ips; under 0.25 per cent at 3 3/4 ips. Dynamic range is 55 db and 50 db at



the higher and lower speeds, respectively. High-impedance inputs are provided for microphones and high-level program sources. Cathode-follower output is approximately 0.5 volt. Azimuth alignment of stereo head gaps in the same stack is within 20 seconds of an arc, equivalent to less than 10 millionths of an inch. The appearance of the 960, in a distinctive gray portable carrying case, is well in keeping with its impressive performance. Ampex Audio, Inc., Sunnyvale, Calif. User net price, \$650.00.

**Matching Amplifier-Speaker.** Engineered for use with the Model 960 recorder is the Model 2010 amplifier-speaker. Matching the 960 in size and appearance, the 2010 amplifier section provides operating characteristics flat within  $\pm 1.0$  db, with total harmonic distortion less than 0.5 per cent, throughout the maximum range of human hearing. The specially-designed 8-in. speaker provides smoothly peak-free response throughout a remarkably wide audio range. User net price, each (two required for stereo playback), \$199.50.

## BELL

● **Cartridge Player-Recorder.** Bell "Stereo-Pak" tape-cartridge players and recorders have been designed to accommodate the new RCA-type stereo tape cartridge. Using the 4-track cartridge at a speed of 3 3/4 ips, the user can obtain up to a full hour of stereo sound on 600 ft. of 1.0-mil tape. Use of moving parts in the Stereo-Pak has been kept to an absolute minimum to insure dependable and trouble-free operation. Only two mechanical

controls govern all operating functions. Wow and flutter content is under 0.25 per cent. Playback frequency response is stated by the manufacturer to be 50 to 15,000 cps. This unusual response figure for 3 3/4-ips operation is achieved by means of a head gap width of only 90 millionths of an inch. The Stereo-Pak preamplifier equalization circuits are especially engineered to take maximum advan-



tage of the head characteristics. All models of the Stereo-Pak incorporate a completely transistorized stereo record-playback preamplifier with exceptionally low hum and noise. Illustrated is Model 405, which includes built in 14-watt (7.0 watts on each channel) stereo power amplifier. An accessory speaker system, Model 450, is available as a matching accessory. Bell Sound Division, Thompson Ramo Wooldridge Inc., 555 Marion Road, Columbus, Ohio. User net price, \$299.95; Accessory speaker system, per pair, \$49.95.

T210 mono rec/pb ..... \$109.95  
T211 mono pb, 1/2 tr ster pb ..... 119.95  
T212 mono rec/pb, 1/2 tr ster pb .... 129.95  
T213 mono rec/pb, 1/2 tr ster rec/pb 149.95

## E.M.I.

● **Battery-Operated Tape Recorder.** This lightweight portable recorder makes possible the reproduction of sound with a fidelity comparable to that of professional studio equipment. Weighing only 14 1/2 lbs., including batteries, and measuring only 14" x 8" x 7", the E.M.I. Series L-2 uses standard 5-in. reels of quarter-inch tape and requires no external power source. It is available in three models: 3 3/4 ips for 30 minutes; 7 1/2 ips for 15 minutes, and 15 ips for 7 1/2 min-

(Continued on page 105)



## CROSSOVER AND BIAMPLIFIER

(from page 48)

### Operation

Selection of the best crossover frequency is done by listening tests only. The gain controls should be adjusted for best balance of treble to bass. These controls should be readjusted each time the crossover frequency control changed. It is best to adjust the gain controls to a high level, and cut the input signals by turning down the level controls in the preamplifier. The author recorded all settings of the gain controls for each setting on the crossover frequency control so that previous listening tests could be duplicated for comparison.

A few words about the speakers used with this amplifier. The author's speaker system includes four speakers. A good quality 15-inch woofer in a back-loaded folded horn is directly connected to the bass amplifier. The middle- and upper-frequency speakers include two 8-inch speakers mounted in the upper section of the same cabinet. Within the same compartment as the 8-inch speakers is a horn type tweeter with a 3000 cycle L-C high pass filter. This arrangement is connected directly to the treble amplifier.

Building the amplifier described in this article was quite a job. However, results have shown that it was well worth while. Until something new comes along, I think this is it!—and the little wife hopes so. Æ

### PARTS LIST

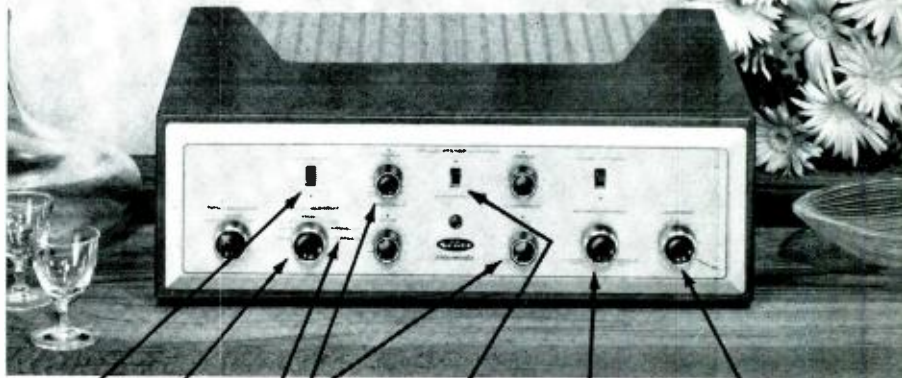
All resistors are 1 watt unless otherwise specified.

$R_{11}, R_{12}$	500 k-ohm pot, linear
$R_8, R_{16}, R_{14}$	220 k ohms
$R_9, R_{17}$	2200 ohms
$R_{10}, R_{18}$	39 k ohms
$R_5, R_{19}$	2.2 megohms
$R_6, R_{10}$	470 k ohms
$R_7, R_{11}$	1500 ohms
$R_8, R_{12}, R_{13}, R_{14}$	22 k ohms
$R_{10}, R_{16}$	2200 ohms, 1%
$R_{11}, R_{17}$	25 k-ohm pot (see text)
$R_{12}, R_{18}$	8200 ohms, 1%
$R_{13}, R_{19}$	100 k-ohm pot (see text)
$R_{14}, R_{10}$	10 k ohms
$R_{15}, R_{11}$	270 k ohms
$R_{16}, R_{12}, R_{13}$	680 ohms
$R_{17}, R_{18}$	47 ohms
$R_{19}$	1200 ohms
$R_{10}, R_{16}$	1.2 megohms
$R_{11}, R_{17}$	47 k ohms
$R_{12}, R_{13}; R_{17}, R_{18}$	47 k ohms (matched pairs)
$R_{19}, R_{21}$	100 k ohms
$R_{22}, R_{20}$	100 ohms
$R_{27}$	100-ohm, 4-watt pot
$R_{28}, R_{29}, R_{31}, R_{32}$	1000 ohms

AUDIO • AUGUST, 1959

# New H.H. Scott Stereo Amplifier has features never before offered at \$139.<sup>95</sup>\*

The new H.H. Scott 24 watt stereophonic amplifier, Model 222, puts top quality within the reach of all. This new amplifier has many features never before available for less than \$200. It is backed by H.H. Scott's fine reputation. Check the features below and you'll see why you should build your new stereo system around the H.H. Scott Model 222.



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Separate Bass and Treble controls on each channel let you adjust for differences in room acoustics and different speaker systems.

This position lets you play a monophonic source such as an FM tuner or a tape recorder through both power stages and speakers.

Effective scratch filter improves performance on older worn records and improves reception on noisy radio broadcasts.

Exclusive center-channel output lets you use your present amplifier for 3-channel stereo or for driving extension speakers. Separate stereo tape-recorder outputs.

Channel balance control adjusts for different speaker efficiencies and brings channel volumes into balance quickly and easily.

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**SPECIFICATIONS:** Dual 12 watt channels; 0.3% 1M distortion; 0.8% harmonic distortion; frequency response 20 to 30,000 cps; extremely low hum level (-80db); DC operated preamplifier heaters; inputs for stereo or monophonic recorders, tuners, phono cartridges and tape heads. Phono sensitivity 3 mv. Sub-sonic rumble filter prevents overload from noisy changers or turntables. Price \$139.95\*

H.H. SCOTT INC. Dept. A-8, 111 Powdermill Road, Maynard, Mass. Export: Telesco International Corp., 36 W. 40th St., N.Y.C.

Insist on genuine H. H. Scott components.

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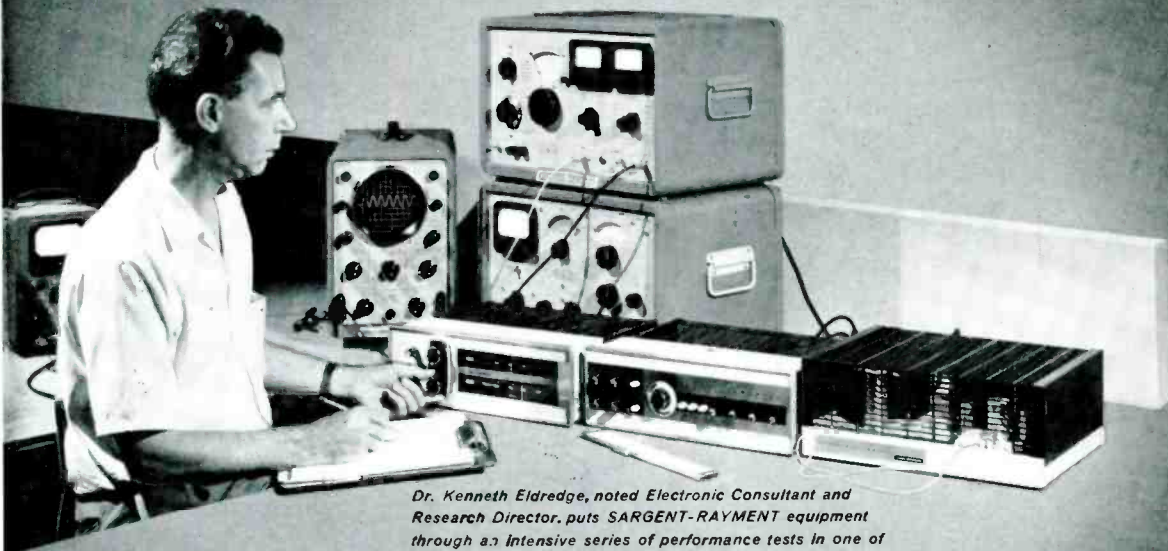


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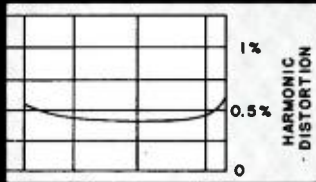
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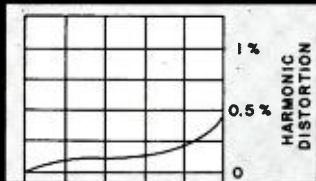
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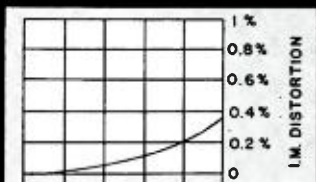
20 CY 100 CY 1 KC 10.20 KC/KC  
FREQUENCY IN CYCLES PER SECOND

FM distortion through entire audio band at full modulation



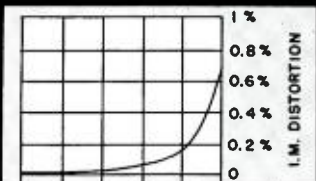
0 20 40 60 80 100%  
PERCENTAGE OF MODULATION

AM distortion of special S-R two-tube detector



0 1V 2V 3V 4V 5V  
I.M. DISTORTION VS VOLTAGE OUTPUT

Tone control, high voltage—low-distortion cathode follower output



0 10 20 30 40 50 WATTS  
I.M. DISTORTION VS WATTS OUTPUT

Amplifier output with all tubes being driven within recommended operating voltages

Photo at left and curves above refer to SARGENT-RAYMENT SR-1000 AM-FM Stereo Tuner (\$184.50), SR-2000 Master Stereo Pre-amplifier (\$163.50), and SR-5100 dual 50-watt Stereo Power Amplifier (\$183.50). These and other S-R stereo equipment fully described in free 12-page brochure available through coupon at left.

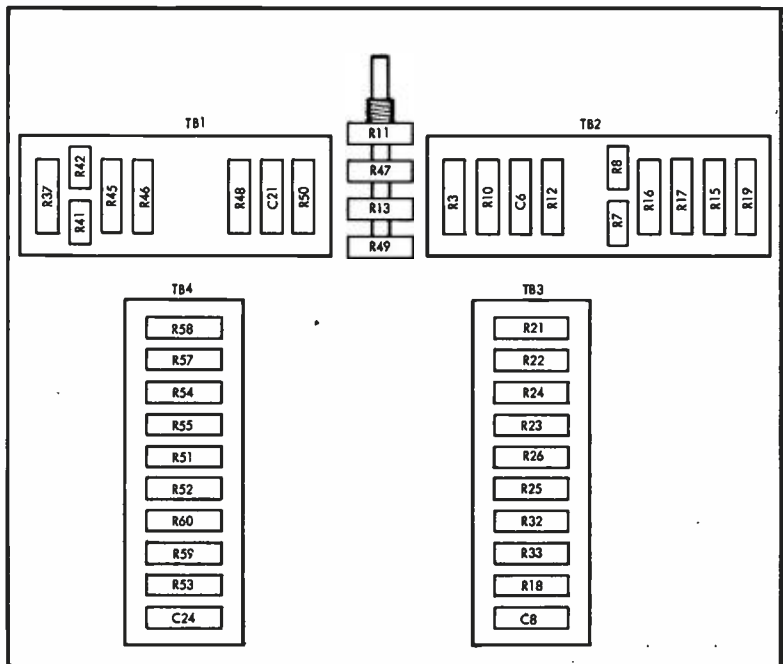


Fig. 7. Layout of components on the resistor mounting boards, and the indicated sections of the crossover-frequency control.

$R_{200}, R_{64}$	300 ohms, 20 watts, adjustable	$L_1$	4-Hy. choke, 200 ma
$R_{211}, R_{63}$	5600 ohms, 2 watts	$T_1$	Ultra-Linear output, Acrosound TO-300
$R_{212}, R_{62}$	25 ohms (matched)	$T_2$	Ultra-Linear output, Dynaco A-430
$R_{213}, R_{61}$	22 k ohms, 2 watts	$T_3$	Thordarson 22R35
$R_{65}$	1000 ohms	$T_4$	117-v primary to 117-v secondary, 35 ma
$R_{66}, R_{60}$	100 k ohms (matched)	$CR_1$	Selenium rectifier, Federal 1002A, 65 ma
$R_{61}$	12 ohms, 1%	$V_1, V_2$	12A U7 tube
$R_{67}$	18 k ohms, 2 watts	$V_3, V_4$	6AN8 tube
$R_{68}, R_{72}$	10 k ohms, 2 watts	$V_5, V_6$	KT66 tube
$R_{69}$	5000-ohm pot, 4-watts	$V_7, V_8$	EL34 tube
$R_{70}$	6800 ohms, 2 watts	$V_9, V_{10}$	5V4GA tube
$R_{71}, R_{74}$	100 k ohms, 2 watts	$J_1$	Phone jack, Amphenol 80-C
$C_1, C_{16}$	.05 $\mu$ f, 600 volts		
$C_2$	.03 $\mu$ f, 600 volts		
$C_3, C_4$	10 $\mu$ f, 475 volts, electrolytic		
$C_5$	0.1 $\mu$ f, 600 volts, 1%		
$C_6$	.024 $\mu$ f, 600 volts, 1%		
$C_7, C_{11}, C_{17}, C_{18}$	20 $\mu$ f, 450 volts electrolytic		
$C_8, C_{21}$	680 $\mu$ f, 400 volts electrolytic		
$C_9, C_{10}, C_{13}, C_{14}, C_{15}$	0.1 $\mu$ f, 600 volts electrolytic		
$C_{12}, C_{14}$	40 $\mu$ f, 150 volts, electrolytic		
$C_{15}, C_{22}$	.25 $\mu$ f, 600 volts electrolytic		
$C_{16}$	.043 $\mu$ f, 600 volts, 1%		
$C_{17}$	.01 $\mu$ f, 500 volts, 1%, mica		
$C_{23}, C_{28}$	20 $\mu$ f, 475 volts, electrolytic		
$C_{24}$	390 $\mu$ f, 1000 volts, ceramic		
$C_{25}, C_{27}$	.25 $\mu$ f, 600 volts (matched)		
$C_{29}$	50 $\mu$ f, 50 volts, electrolytic		
$C_{30}, C_{31}$	40 $\mu$ f, 500 volts, electrolytic		
$C_{32}, C_{33}$	30 $\mu$ f, 475 volts, electrolytic		
$C_{34}, C_{36}$	0.1 $\mu$ f, 600 volts, bathtub $2 \times 0.1$		
$F_1$	5 amperes, Littelfuse 3AG		
$F_2$	$\frac{1}{4}$ ampere, Littelfuse 3AG		

#### TECHNICAL DATA

##### Power output:

Treble channel ... 20 watts

Bass channel ... 50 watts

Power input ... 222 watts, 117v

Input voltage for 12 watts output, crossover at 500 cps:

Treble channel ... 0.7 volts

Bass channel ... 0.9 volts

##### Hum:

Treble channel ... 95 db below

20 watts

Bass channel ... 80 db below

50 watts

##### Crossover data:

Frequency range ... 100 to 1,200 cycles

Attenuation ... 8 db (approx.) per octave

Note: Test equipment was not available for intermodulation tests.

Total harmonic distortion was less than 2%. However this was for the entire system (using a Test Record).





## CHARLES A. ROBERTSON\*

### STEREOPHONIC

George Gershwin At The Piano

20th Fox SFX3013

Piano Roll Discoveries

RCA Victor LSP2058

When entertainment in many homes centered on the player piano, Aeolian Duo-Art was one of the most famous imprints of the time, claiming the same respect as trade names on high quality audio components enjoy today. Where the ordinary pianola clattered away with unvarying clangor, unless the operator was a skilled manipulator of both foot-pump and pedals, the Duo-Art was fed nuances of phrasing and dynamic shading from a series of holes along the sides of the roll. The company staged blindfold tests during the Twenties that were forerunners of the current "Live vs. Recorded" concerts. Among the pianists it employed was the youthful George Gershwin, who made rolls for a decade, beginning in 1915, and near the close of the period cut his own reading of the complete *Rhapsody in Blue*, a performance reclaimed on both these discs by the latest stereo techniques.

By delving also into the archives of a sister subsidiary, 20th Century-Fox gives the fullest portrait of the composer at the keyboard yet unveiled, presenting him at four stages in his career. First there is the journeyman pianist of 1920, relaying the songs of others in true piano-roll style, as exemplified by *Left All Alone Again Blues*, *Grieving For You*, *I'm A Lonesome Little Raindrop*, and *Just Snap Your Fingers At Care*. Five years later, just before his writing activities limited his professional appearances, he is playing his own compositions in the *Rhapsody*, and *That Certain Feeling*. Then in 1929, via Fox Movietone News and the transfer from optical sound film to magnetic tape, he is heard directing a rehearsal of "Strike Up The Band," leaving his post at the piano momentarily to engage in banter with the comedy team of Clark and McCollough. Finally in 1931, the newsreel cameras pick him up again at the opening of the Manhattan Theatre, an occasion enlivened by his impromptu variations on *I Got Rhythm*.

Because the familiar strains of the *Rhapsody in Blue*, as orchestrated by Ferde Grofe, have filled the channels of mass communication for so long, many listeners have lost an early enthusiasm for the work. An opportunity to hear the composer's original piano version is likely to stir their interest anew. Perhaps it will even convince Ira Gershwin and the Gershwin Estate, whose approval was needed for these recordings, that a modern orchestration is in order. A commission to Robert Prince, Gil Evans, Johnny Mandel, or even Leonard Bernstein could do much to prevent it from becoming a period piece.

Both projects were carried out at RCA Victor studios and an impressive list of engineers was involved. William Jordan and Douglas Williams were from 20th Fox, and Lou Layton, Michael Crawford and Paul Hoffman represented Victor. Alphonso D'Artega made sure the Imperial-Industrial electric reproducing

piano performed on schedule. Either is to be preferred in stereo, but those who want both may be satisfied to take one in monophonic form.

Among a sampling of other piano-roll specialists, Victor includes, in addition to Gershwin's major opus, his version of *Whose Baby Are You?* A second look at the label may be required to convince you that the question comes from Jerome Kern. A younger generation, fresh in the knowledge that Thelonious Monk sometimes lampoons Zee Confrey, can learn the rest of the story as related on *Stumbling*, a piece of his own devising, and *The Sheik of Araby*. For those who do remember, the rewind and flapping noise at the end of a roll are retained.

Other composers playing their own works are Felix Arndt on *Nola*, Lee S. Roberts and Max Kortlander with *Smiles*, and Fats Waller on *Squeeze Me*. Of most worth to jazz students is the daddy of them all, James P. Johnson, stating *I Ain't Givin' Nothin' Away*, and Victor can do no better than locate enough of the rolls he and Waller cut to make up a sequel.

Ray Bauduc-Nappy LaMare: Two-beat Generation

Capitol ST1198

Ruby Braff: Easy Now

RCA Victor LSP1966

When played in tandem, these albums comprise a pleasant sector in jazz chronology and are planned with some thought for the advantages of stereo placement. In fact, the Bob Crosby alumni based on the West Coast go outside their own little group to Jack Marshall for arrangements. He provides a chase between two trumpets on *Coffee House Rag*, and shifts the players about to suit his fancy before each number. His other work on this label indicates that he has made quite a study of the problem. Guitarist Nappy LaMare sings on *Papa's Gone*, *Good Bye*, and Ray Bauduc is as sharp a drummer as ever. Gene Bolen's clarinet is pure New Orleans on *My Inspiration*, and Jackie Coon alternates on trumpet and mellophone. Among the dozen tunes are *Smokey Mary*, and *De Paris' Martinique*.

Ruby Braff, heading two casts, affords protracted examples of trumpet interplay. On six tunes with a sextet, his respondent is Roy Eldridge, who sends back rapierlike sallies on *This Is My Lucky Day*, and *Someday You'll Be Sorry*. By switching in midstream toflugelhorn, he gives a firm underpinning to Braff's lyric sentiments. In an octet, with the added voices of Vic Dickenson, trombone, and Bob Wilber, tenor sax, Braff meets Emmett Berry, playing one original as well as *My Walking Stick*, and *Willow Weep For Me*. The horns blend admirably in stereo on each occasion.

The Music From M Squad

RCA Victor LSP2062

Benny Carter: Aspects

United Artists UAS5017

With the halfway mark passed, it seems more than certain that this year will be remembered for the resurgence of Benny Carter in all his many capacities. One Contemporary album is behind him, and a second will unite him with Earl Hines. Also on the credit side

is his first big band date in more than a decade, and the major role he assumes in the music for television's "M Squad." Although he shares the writing about equally with Johnny Williams and Stanley Wilson, the musical director, his alto sax weaves assuredly through solos on nearly every number and is especially compelling on *A Lady Sings The Blues*. Considered as jazz, the score is the most meritorious to emerge from the private-eye dramas. Recorded by Al Schmitt at RCA Victor's new Music Center of the World, the sound strikes a happy medium between that of most recording studios and the larger movie sound stages.

Carter salutes the months of the year on his big band session, composing four originals to fill out the requisite amount. The personnel lists the familiar names of Hollywood studio musicians, including Shorty Sherock, Pete Candoli, Buddy Collette, Barney Kessel, and Shelly Manne. Here his characteristic setting for the entire sax section, balanced admirably in stereo, is as rewarding as the featured solos. Ideal for dancing, it offers a pleasant change from most West Coast units.

Bill Evans: Everybody Digs Bill Evans

Riverside Stereo RLP1129

All the elements which make Bill Evans a musician's pianist are winningly exhibited on his second album. Gifted with a fine and sensitive ear for melody, he combines a concise, impeccable touch with an unflinching sense of rhythm. On *Peace Piece*, a long original solo excursion, he passes around a set of variations in the impressionistic style first brought to jazz piano in the compositions of Bix Beiderbecke. In other hands, a notable exception being Jess Stacy, this approach is often refined into amorphous wandering that bears little relation to jazz or Debussy, from whom it stems. Evans restores its masculine vigor, renewing it through a telling use of modern phrasing. Also unaccompanied are *Lucky To Be Me*, and a brief *Epilogue*.

Otherwise, his companions are Sam Jones, bass, and drummer Philly Joe Jones, who curbs any tendencies to become overpretty on *Night and Day*, *Tenderly*, and *Young and Foolish*. The trio is joined effectively in stereo.

The Vibe Sound Of Peter Appleyard

Audio Fidelity AFSD5901

Terry Gibbs: More Vibes On Velvet

Mercury SR80027

The amount of straight melody coaxed from the vibraphone in these two efforts is enough to please the most demanding must-hear-the-tune auditor. Both musicians have good reasons for not breaking into fervid but less lyrical embellishments. Since arriving from Canada in 1954, Peter Appleyard has gained a working acquaintance with the preferences of club patrons on this side of the border. His first LP for local consumption is based on a knowledge of what the more lucrative segment of his audience demands. Briefly, it is the Jonah Jones formula of singing lines and a personal touch. He fills the prescription on *Avalon*, *Just in Time*, and *'S Wonderful*. Centered between bass and drums in stereo, the vibes are crystal clear.

"It's very hard to play straight melody on vibes," is the way Terry Gibbs notes his sentiments, "You keep wanting to play little figures and things around the tune and it's really tough to stay on the melody." Among his inducements are five new ballads, set to lyrics by his wife. He wrote four himself, and delivers them in slow, persuasive tempos. His tones are equally subdued on *Moonlight Serenade*, *Blues In The Night*, and Steve Allen's *Impossible*. Rich saxes, arranged by Manny Albam, surround the vibes in stereo.

Clark Terry: Top And Bottom Brass

Riverside Stereo RLP1137

Noting that the relationship between the trumpet and tuba is actually the same as that of violin and double bass, Don Butterfield prefers to regard his tuba as a "contra-bass trumpet." A member of the orchestra at Radio City Music Hall, he met Clark Terry when the Ellington trumpet man did a guest appearance on stage. Together they worked out the idea of combining the two instruments in a unique front line, enriching it further with

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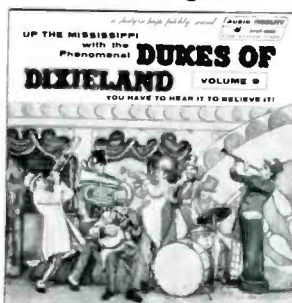
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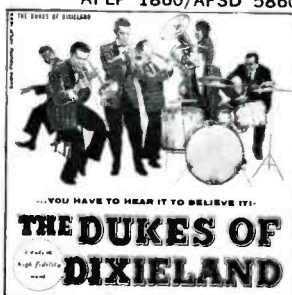
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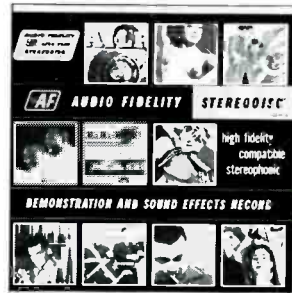


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the full voice of Terry's flugelhorn. He also utilizes his trumpet mouthpiece, in a light-hearted recasting of the unbridled jungle sounds of the wa-wa mute, on an original blues. Following this example, Butterfield removes his tuba completely from a subsidiary role, permitting it to charge like a wounded rhino through a longer blues.

Besides engaging in sprightly collaboration on *My Heart Belongs To Daddy*, they investigate march and waltz tempos. In evading the tuba, bassist Sam Jones' work is cut out for him, and Jimmy Jones, piano, with drummer Art Taylor completes the quintet. Butterfield states that his tuba, in the title tune, picks up a unison B flat from Terry and descends through its register to pedal B flat, the last black note on the piano keyboard. Quite a test for your equipment, as well as for everyone concerned in the processing, particularly Jack Matthews, of Components Corp., who made the stereo master.

**Leon Bibb: Folk Songs**

Vanguard VSD2012

**Jimmie Driftwood: The Wilderness Road**

RCA Victor LSP1994

If these were jazz artists it would be impossible to cover them under the same heading. Fortunately, the collector of folk songs seeks broad experience and is catholic in his approach, qualities some jazz enthusiasts might well adopt. As the folk contingent is already hot on their trail, these new discoveries are grouped together because their first LPs belong in any collection. Experienced in Broadway musicals, Leon Bibb is a polished performer and brings the dramatic intensity of a Harry Belafonte to his material. It includes songs from prisons and chain gangs, blues and love songs. He also is benefited by the accomplished assistance of Fred Hellerman and Milt Okun, who frame his voice with a guitar, harmonica or choral group, depending upon the nature of his role. The stereo recording is splendid.

Jimmie Driftwood was introduced to a New York audience at an Alan Lomax concert in Carnegie Hall, and his national fame rests on *The Battle Of New Orleans*, the hit song he revised from a 140-year-old version. Of the dozen songs gathered here, all are charming bits of Americana and carry an appeal not dictated by hit-parade requirements. Some may end up there, however, notably *Four Little Girls in Boston*, and the tale of *Peter Francisco*, the Paul Bunyan of the Revolutionary War. Besides accompanying himself on guitar, Driftwood interjects solos on the "Pickin' Bow," which is held in the mouth and played with a pick, sounding like an oversize Jew's harp. The woody effect is enhanced by a Nashville recording which seems to have him sing through a hollow log. Stereo enlarges the log and nothing could remove the hard-cider twang from his voice.

**Highlights Of Vortex**

Folkways Stereo F556301

The music of Vortex, described as a new kind of theatre, was composed for a series of sound experiments at San Francisco's Morrison Planetarium, where the audience is surrounded by a circle of thirty-eight speakers. An added sound source is two speakers in the center of the domed auditorium, and a control panel channels the taped compositions to any combination required, or selects them in series for rotational playback. This electronic music differs from its parent Musique Concrete, a recent import from Europe, in that it is meant to be combined with visual effects. The auditory treats on each program are accompanied by moving patterns and flashing colors obtained from the planetarium's intricate lighting system and a battery of Vortex projectors. Its dissemination throughout the globe is now in the hands of the Audio-Visual Research Foundation.

Of necessity, its composers are wizards with a tape recorder, and two have close associations with the jazz world. William Loughborough, creator of the "boo hoo" and other percussion instruments, has toured with Chet Baker to demonstrate his inventions. His polyrhythmic study, *For the Big Horn*, had its initial playback through an exponential loudspeaker which he built with



a mouth twelve-feet in diameter. Henry Jacobs, originator of the project with Jordan Bellson, is known in another incarnation for his research into the weird life of Shorty Pettestein for World-Pacific. His works included are a film sound track, two mood pieces, and a study in amplified Haitian drums and Indian tabla.

An employee of the Ampex Corporation, Gordon Longfellow gives the name of one of its prize products to *Three Fifty Dash Two*, creating echoed rhythms from the sounds of a musical saw, electric mixer, engine noises, pots and pans. He also extracts mammoth reverberations from plucked piano strings in a three-part suite. David Talcott, a staff member at radio station KPFA in Berkeley, conducts four experiments using delay loops and the human voice.

To be believed, it must be heard, regardless of the visual attractions present at the time. The stereo effect is contrived without strict adherence to the position of the sounds as originally generated. Listen carefully and your ears will be alerted to some of the stereo tricks engineers can play on ordinary everyday music.

## MONOPHONIC

### Snooks Eaglin: New Orleans Street Singer Folkways FA2476

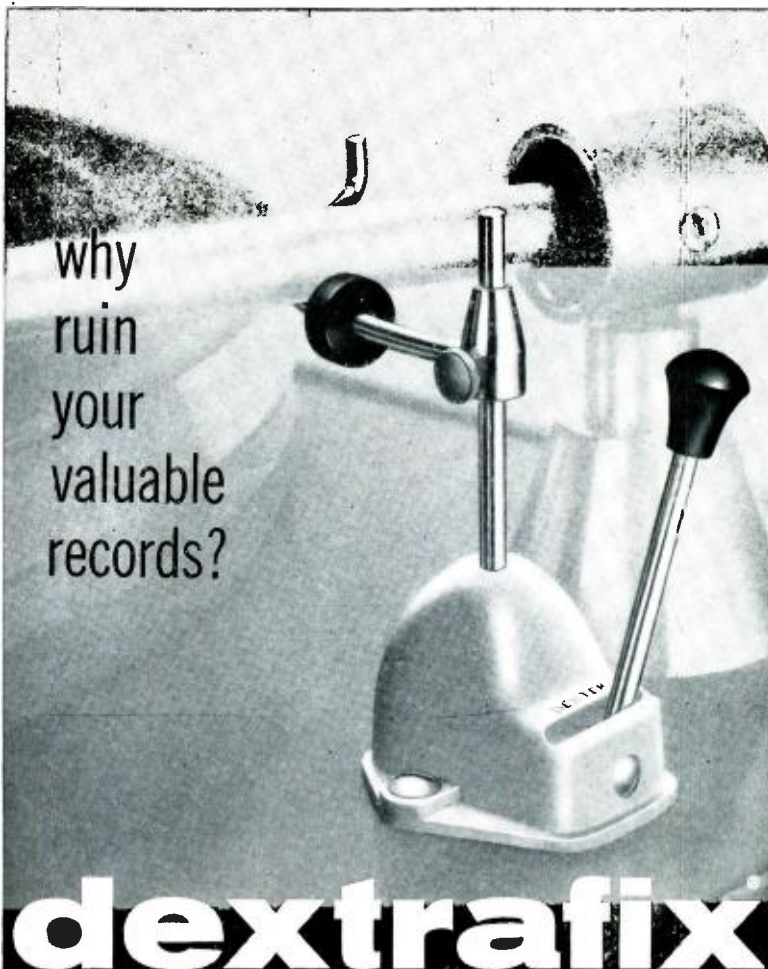
Heard briefly in the first volume of Samuel Charters' "Music of New Orleans," Snooks Eaglin now has an album of his own, through the courtesy of Dr. Harry Oster, of Louisiana State University, who recorded him on home grounds in March, 1958. A minstrel walking the streets of the city today, he became blind at the age of two and taught himself to play a guitar received on his sixth birthday. After revealing that most of his songs were learned from the radio and recordings, the notes pose a question as to how many other folk artists obtained supposedly "authentic" material in the same way. It is pointed out that these sources, the bane of believers in the oral heritage of songs passed from singer to singer, need not always carry a commercial stigma. True enough in this case, which is no valid test of the theory, as Eaglin is a natural blues singer and goes direct to the heart of a song to make it his own. He restores basic emotions and pares away nonessentials. Someone should send him a Ray Charles album.

He simulates the traditional solo breaks on *High Society*, playing without a pick, and his one original is a striking instrumental blues. Choosing from his vast repertoire, he selects both old and new, proving at twenty-two that street singers are not a thing of the past. For a field recording, the sound is better than usual.

### Blues In The Mississippi Night United Artists UAL4027 Lil Armstrong: Satchmo And Me Riverside RLP12-120

Two valuable additions to the spoken documentation of the music which coursed along the Mississippi River in the first part of this century are made on these recordings. Amateur tape recordists should take hope on learning that seventeen years have passed since Alan Lomax set up his portable disc machine and encouraged three unidentified blues artists to tell their stories. Aside from the primitive sound, about the only point to be regretted is that it took so long to reveal his interview formula. A model of its kind, it places Lomax in the background, interrupting the flow of experiences only with short musical examples and casual prods from the leader of the group. Although he might find a trio willing to speak with equal frankness today, the responses would be different and carry less import. Essential to a study of the blues and Southern folk mores, the text is transcribed in full on an enclosed folder and will form part of a book Lomax is writing.

Lil Armstrong's tale of life in Chicago with her noted husband during the Twenties deserves a place beside his autobiography. It is jam packed with personal memories, from her first meeting the shy youth who was King Oliver's new trumpet player to the final



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breakup of their marriage. Her enthusiasm for the subject is only slightly dampened by an interrogator who seems to have just met her at the studio. How much more ground would be covered were she allowed to cut up old times with someone like Luis Russell and Buster Bailey! Lomax shows how to avoid the formality of questions and answers. In the next installment, Riverside should put Louis in a room with Milt Gabler and Joe Glaser.

Art Blakey: Holiday For Skins, Vol. 1  
Blue Note 4004  
Hi-Fi Cuban Drums  
Capitol T10141

A campaign to educate the populace about drums is continued by Art Blakey, who conducts his annual seminar with wonted gusto. His elucidators include a septet of Afro-Cuban percussionists, headed by Sabu and arrayed to furnish a background of contrasting rhythms for challenging statements from three jazz drummers. In addition to the leader, they are Art Taylor and Philly Joe Jones, whose ceremonial chanting prepares for the bacchannalian rites of *The Feast*. Atmospheric passages are supplied by Donald Byrd, trumpet, and Ray Bryant, piano, while Wendell Marshall is a steadying influence on bass. The first of two volumes produced in an all-night session, it provides an exciting sequel to last year's "Orgy in Rhythm," which will be among Blue Note's initial stereo releases. This latest installment should follow shortly.

Blakey is interested in telling a story and takes his material from a number of sources, drawing greatly on the three years he spent in Africa. He will find his language spoken by the corps of drummers assembled in Havana, where they were recorded for Capitol by Ramon S. Sabat. Some were brought in from the hills to demonstrate the wild rhythms of native dances, before ballroom polish was applied. Assorted gourds are struck, scraped and shaken, along with various discarded agricultural implements. The deep bass sounds come from the marimboola, made of metal straps cut from the main-springs of broken, hand-wound phonographs. And you can't hardly get those kind anymore!

Al Hirt: Swingin' Dixie  
Audio Fidelity AFLP1878

If forced to trim his rampant lines to fit band arrangements, Al Hirt would be a carbon copy of Harry James. As it is, he combines the swing trumpet style with the brashness of a Wild Bill Davidson, resulting in a fiery and unquenchable combustion. Not a thought in a carload, apparently, and this is the way many individuals prefer their Dixieland. Hal Cooper, his clarinetist, is known from early Dukes of Dixieland recordings. Bob Havens, trombone, and Paul Edwards, drums, played in the band of the late George Girard. Bob Coquille, bass, and Ronnie Dupont, piano, are simply natives of New Orleans.

Hirt's recent departure from the Crescent City for the rarified atmosphere of the Palmer House is commemorated on *Chicago*. The dozen tunes on his second album are all tried and true, from *Darktown Strutter's Ball* to *Sonny of the Wanderer*. Included is Harry James' "Feet Draggin' Blues," and a robust *Battle Hymn of the Republic*.

Roy Bryant: Alone With The Blues  
New Jazz 8213  
Ramsey Lewis: Down To Earth  
Mercury MG36150

No jazz pianist worthy of the name can neglect the blues, although record executives usually feel no such obligation. Given the opportunity to express himself at will and unaccompanied, Ray Bryant reaches back to basic principles on five striking originals. Organized in a variety of shades and colors, they incorporate the plaint of early blues singers, the spiritual release of gospel song, and the glad, swinging approach of the stride pianists. Bryant started as a bass player and his left hand is strongly developed. He uses it in a distinctive manner that avoids the imitations of period or style. The blues

feeling is also projected on *Lover Man*, and a restful *Rockin' Chair*.

The Ramsey Lewis trio, once billed as "The Gentle-men of Jazz," steps out in a new guise, distinguished mainly for an improvised blues lasting five minutes. Here the group's former restraint disappears completely, but the controlled teamwork remains. Falling somewhere in between this performance and the soft-sell are tasteful investigations of *Greensleeves*, *Dark Eyes*, and *Come Back to Sorrento*.

Humphrey Lyttelton: I Play As I Please  
London LL3101  
Dizzy Reece: Blues In Trinity  
Blue Note 4006

Unless employed in the section of a big band, most British trumpet players hew close to traditional lines. Those who try to branch out into other styles are apt to find their following falling away and dates hard to find. Because of his stature as a pioneer in the New Orleans revival, Humphrey Lyttelton has negotiated the transition to mainstream jazz with fair success, fronting a septet in his own London Club. Fresh from two-months of concerts behind Jimmy Rushing, it is steeped in the blues for this session and develops three original themes with a vigor matched by few studio groups in this country. Kathleen Stobart, a blue-eyed blonde lady on tenor sax, is guest soloist on Johnny Hodges' *Going Out the Back Way*. For one set, it is augmented to thirteen pieces by Don Rendell's group featuring Ronnie Ross. A Pnseo band, outfitted with marimba, bongos and timbales for the Spanish tinge on *La Paloma*, almost finds the leader returning to his Hot Five period.

Dizzy Reece, on arriving in 1948 from Kingston, Jamaica, started from scratch and now enjoys considerable respect among the house guard and visiting American musicians as a modern stylist. When engagements were slim, he would slip over to the Continent and won many fans in Paris, where this recording was made last year. As the title implies, it is most notable for his warm exposition of original blues themes. His work is remarkably free from traces of other trumpet men, possibly because he learned a great deal from an association with Don Byas, the expatriate tenor saxist with whom he traveled about Europe. Two tourists, Donald Byrd and Art Taylor, join in, and Tubby Hayes makes an eloquent tenor-sax solo of *Round About Midnight*.

Both leaders score one point over traditionalist compatriots whose best efforts always belie the place of origin. In their case, it is almost impossible to tell.

Hampton Hawes: Four!  
Contemporary C3553  
Roy Haynes: We Three  
New Jazz 8210

Technique, as applied to a jazz pianist, is a word to be weighed carefully in the balance, an axiom well illustrated in the careers of Hampton Hawes and Phineas Newborn. The son of a preacher, Hawes grew up on church music and the blues, first broadening his style to include Charlie Parker's conception of time. Since then, a slow process of absorbing ideas and new material was guided by his aversion to "technique that sounds like technique." But there was always enough for what he wanted to say, especially on his blues originals, one of which is featured here. Topping a set of standards is Parker's *Yardbird Suite*. Red Mitchell records his first bowed bass solo on *Boo Jee*, abetted by Barney Kessel, guitar, and drummer Shelly Manne.

Newborn's debut drew acclaim for the brilliance of his playing, and he has suffered from it ever since. The need to live up to his notices has hindered his growth, although some mentioned his lack of maturity. Now, in an effort to play less and say more, he assumes a secondary billing to Roy Haynes, a drummer who spent five years backing Sarah Vaughn. The pianist comes to grips with blues on *After Hours*, where his soul-searching choruses make this his most interesting LP. He includes two Ray Bryant tunes, and one original. With Paul Chambers on bass, Haynes lends encouragement or trims sails to suit prevailing winds.

**Barney Kessel: Some Like It Hot**  
**Contemporary M3565**

As the only new tune in this album bears the film title, Barney Kessel needs little prompting from the score to revisit prohibition days. Both he and Shelly Manne helped record the sound track, however, and the perils thrust on Pearl White must seem mild after a vision of two Chicago musicians harried by gangsters and Marilyn Monroe. Out of sympathy, they are impelled to adopt the free and easy manner of the Windy City and blow modern breezes through old favorites. Manne pummels a suitcase a la Josh Billings, while Kessel switches to unamplified guitar on *Sweet Sue*. Joe Gordon, a former Gillespie trumpet man, finds cadenzas missed by Clyde McCoy on *Sugar Blues*. Besides playing alto and tenor sax, Art Pepper explores the lower register of the clarinet on *I Wanna Be Loved By You*. Pianist Jimmy Rowles and bassist Monty Budwig strengthen the septet's allout choruses on *By the Beautiful Sea*, and *Runnin' Wild*.

Kessel has the added support of Jack Marshall on rhythm guitar, and they combine in duets on *Stairway to the Stars*, and *I'm Thru With Love*. There is enough of a hint of what to anticipate in stereo here to advise waiting for it. On two numbers, Kessel uses a bass guitar, with a range as deep as a bass violin, and believes this to be the first time it was recorded as a solo voice. An interesting sound, and the way his deft fingers keep it from conflicting with the bass is another reason for his top rating as a guitarist.

**Theodore Bikel and Geula Gill: Folk Songs From Just About Everywhere**

**Elektra 161**

**William Clauson: Clauson In Mexico!**

**Capitol T10205**

Where folk singers once remained close to their national heritage, the modern professional is becoming more and more a cosmopolite. Tours embracing several foreign lands make it impossible for concert artists to resist adding to their repertoire, and those staying at home follow their example by means of recordings. Since leaving her native Israel, Geula Gill traveled in South America and Theodore Bikel has been just about everywhere else. They unite in the songs of eleven nations, sung in ten languages other than English. As might be expected, they are most comfortable with Hebrew music and tend to select material of a similar nature, no matter what the origin. Dov Seltzer and Fred Hellerman helped plan trips to Bolivia, Roumania, Brazil, Persia and Argentina, while Billy Faier assists on banjo.

William Clauson's first album was recorded in New Zealand in English, and his second in Stockholm in Swedish, Norwegian and Danish. When at home, the big, blond Swedish-American lives in California, relatively close to the source of the dozen songs which take him south of the Rio Grande to a studio in Mexico City. He sings them in Spanish with El Mariachi Mexico, giving the willing little band of mariachis a cheerful guitar lead. He prefers a livelier beat than is usual, imparting a new zest to Veracruz, Guadalajara, and Malagueña.

**Djamal Aslan: Lebanon 20th Fox 3001**  
**An Evening In Beirut Capitol T10189**

After being introduced to the seductive music of the Middle East by Mohammed El-Bakkar, those adventurous souls whose appetite for strange sounds remains unappeased will welcome the opportunity for further indulgence. An accomplished oudist, Djamal Aslan is gifted with a romantic voice which transcends language barriers. As a composer, he shows a knowledge of Western rhythms, sometimes incorporating them in tunes meant for the younger set. And his six years at the Conservatory of Music of the University of Cairo enables him to give an authentic pulse to the singing and handclapping of a twenty-seven voice chorus under Edouard Ghazal. Since arriving on these shores, he has appeared in concert at the Library of Con-

(Continued on page 104)



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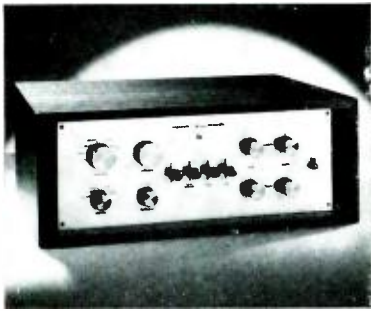
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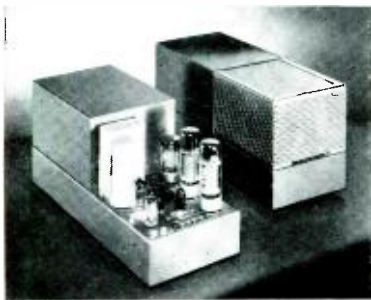
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# RECORD REVUE

## Needed—A Listening Room!

*Seawance, Tennessee*

I'VE DONE MY BEST—but I just couldn't review any records for you this month. The reasons are interesting.

If you have read AUDIO, ETC. in this issue, you will know what happened upon my arrival here in lovely Tennessee, where the temperature ranges around 5 degrees lower than that of New York City, given a good hot spell. It wasn't the heat that got me but the liveness.

I brought down with me something like 500 LP records, mostly stereo, including all the recent ones I could lay a hand on; I toted along two complete stereo systems—four speakers—just to be sure I could play them. And yet in the first nine days here, I got to play just one-half a record.

Now I understand. What I should have done was bring (a) maybe 20 records and one "hi-fi" and (b) I should have hired me a trailer and filled it up to the brim with every rug, blanket, pillow, mattress and other sound-deadening device I could locate, plus any extra rolls of cotton batting, quilting, insulation, and what-not that could be commandeered for the occasion. Then, perhaps, I could have furnished you'all with a few nice, authoritative record reviews, out of a reconditioned and sound-deadened Southern classroom.

Nope, (this is written later than AUDIO, ETC.)—I didn't get to use that gorgeous big fraternity house room, the only available one in this town that has really proper living room acoustics. Instead, I went around the campus searching for something else—and was I amazed. One place after another I tried—front halls, lounges, coffee rooms, class rooms, pool rooms, play rooms, common rooms—and not a single one of them had so much as a stitch of soft material in them. Seems to be a policy of the University of the South, which might just have something to do with that old Suthunn problem, dampness and mildew.

What I must point out to you is simply that under really poor listening room conditions, record listening is just plain impossible. Even with the fanciest hi-fi equipment on the market.

I will review you any good LP record at all on a portable table-top "hi-fi", if you will give me a good listening room for it. And I'll stand back of my opinion, against all comers. But in a bare class room, a swimming-pool-style lecture hall, you could not drag me into writing three words about any recording, no matter how superduper the hi-fi. And so—on principle, I give you no reviews this month. Take a month off, everybody, for silent contemplation, upon the importance of the listening room.

P.S. I have finally found a nice old band practice room and fixed it up tolerably well—just tolerably. It was entirely bare, as usual; but the floor was of wood, not tile, and the walls were wallboard, painted

white. Live as all get-out but not as live as my earlier concrete class room nightmare.

I spent two days in search of rugs. There weren't any. Finally I got into the store rooms of two college dormitories, closed for the summer, and came forth with about six floor-rags of the rubber-backed type, in all states of discolor. (One of them stank so badly I had to wash it in the shower room with Cheer,\* to cheer it up.) I also snatched

\* Plug.  
a big green square of the same, clean and about 10 by 12, from a private bed room, took all my car blankets along—and managed to dampen down that band room so that it is now merely *very* live. Not violently live. And I'm playing records again.

\* \* \*

While I'm at it, I'll present some cogent rules for listening-room acoustics.

1. The right acoustics (and the right room configuration, for stereo) are *more important than any other factor* in record listening—more important than all the fi in the whole chain of sound reproduction. Flout this law at your own risk.

2. There is a fairly wide tolerable area in which we can enjoy recorded sound, ranging from fairly live to fairly dead (with other more complex factors such as room size and shape put aside for the moment). But beyond this area—much too live or much too dead—listening progresses from difficult to impossible. The sound-message simply is not adequately received by the brain.

3. Stereo reproduction *greatly extends this range of tolerance in the dead direction*—indeed, almost to extreme deadness in the listening acoustics. The deader the room, the greater the audible difference between mono and stereo sound. This is a major virtue of stereo.

In the direction of too much liveness, stereo simply merges with mono sound into an unintelligible jumble.

4. A vital point: within the tolerance area of listening liveness, we are able to learn, *after long familiarity*, to ignore the listening effect of our own rooms in favor of the objective effect of the recorded sound. We hear the record; we close our ears to the room. This is a major factor in good listening and accounts for our general agreement, such as it is, concerning the qualities of this or that recording.

But—in a new, a strange listening place, we must begin all over again and re-educate our ears to the new sound, before we can hear our records as before. (Note that the same principle also applies to new reproducing equipment, notably the loudspeaker.)

5. *In a new or unfamiliar listening place*, those records which compensate for the existing conditions will sound best. Thus in an abnormally live room, your dearest recordings will sound fine, but the records with larger built-in liveness will be a



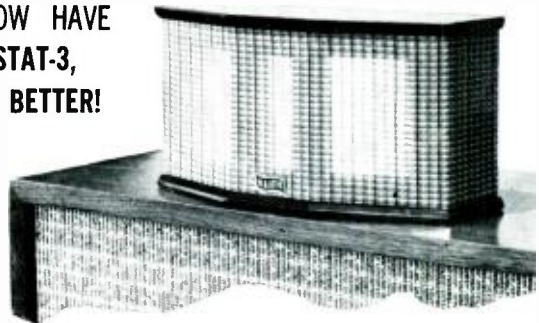
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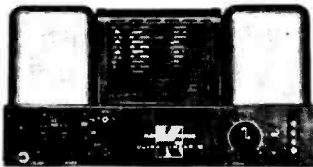
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jumble. Similarly, in a dead room your very live recordings will come out on top.

But, again, long familiarity with the listening room will tend to cancel out these effects.

Keep this in mind when entertaining friends who don't know your listening room, or in giving lectures and record demonstrations in strange places. Suit the record to the listening room—in reverse.

6. An excellent objective test for room liveness is the sound of a close-to recorded speaking voice. In a good room it will sound natural, unforced, realistic. In an overly-live room, the vocal sound has a tell-tale hollow, metallic quality (which seems to be in the recording, of course). In a dead room, the recorded voice will seem startlingly close to you, the sibilants much too distinct, the over-all sound rather bassy.

7. A final, and to me inexplicable, rule:  
a. In an ultra-live room, reproduced music seems *drastically to lack highs*; the middle range is pipey, metallic, hollow, the bass is hugely exaggerated. (Cf. AUDIO, ETC.)

b. In an ultra-dead room, oppositely, the highs seem strident and hissy, the bass is unimpressive in effect, though present.

You figure that one out for me. **Æ**

## NEW LITERATURE

• **Valor Instruments, Inc.**, 13214 Crenshaw Blvd., Gardena, Calif., will mail free a 4-page pamphlet which discusses the maximum power dissipation in transistors. Methods of determining the maximum power which may be dissipated by a transistor and the effects of maximum power dissipation on circuit considerations are illustrated. Factors to consider in arriving at an allowable collector dissipation such as thermal runaway are also explained. This is an excellent treatise for the audio design engineer. **E-1**

• **Electro-Voice, Inc.**, Buchanan, Mich., has just released Catalog 120A, a descriptive new guide to Electro-Voice professional microphones. This complete catalog contains the photograph, response curve, polar pattern, wiring diagram, dimensions, and complete specifications for each microphone. A copy of this informative booklet should join the technical library of every broadcast station, motion picture studio, and recording studio in the country. It will be mailed upon written request, or may be obtained from E-V distributors. **E-2**

• **Unimax Switch Division, The W. L. Maxson Corporation**, Ives Road, Wallingford, Conn., presents detailed information on the expanded line of Unimax snap-action precision switches in its new 28-page Catalog No. 359. Convenient pictorial index shows where to find dimensional drawings, descriptions, force and movement specification tables, and electrical ratings for each Unimax switch listed. Data on bases, terminals, circuit arrangements, and NEMA standard definitions of sensitive switch terms are also included. Requests for copies should be directed to the attention of Mr. J. Martinez. **E-3**

• **Ohmite Manufacturing Company**, 3630 Howard St., Skokie, Ill., has done the electronics industry a distinct favor with the publication of its new Catalog No. 30. Complete in every respect, well planned and clearly printed, this catalog should be in the hands of every person engaged in the purchase of electronic gear on a professional scale. Design and production engineers alike will find this comprehensive listing of Ohmite products to be of great value in their work. Available on written request. **E-4**

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## TAPE GUIDE

(from page 40)

restoration will be complete. Therefore it is all the more desirable in this situation that the tape recorder be capable of being driven by a signal well below 0.5 volts.

The sensitivity required for microphones depends a great deal on the type of microphone used. Of the two types most apt to be used by the home recordist—piezoelectric and magnetic microphones—the latter generally produce considerably less signal. At ordinary speaking levels a few feet distant, the magnetic microphone may produce about 2 or 3 millivolts at average levels and perhaps 10 to 15 millivolts on peaks. Allowing for a reasonable reserve of gain, an input sensitivity of about 2 millivolts is desirable.

### Output Level

If the tape machine (that is, the signal from the tape amplifier) is played back through a high-fidelity system, most often it will be fed to the control amplifier, which generally can be driven to the desired level (enough to drive the power amplifier and speaker in turn) by signals of about 0.1 to 0.5 volts, depending upon the particular control amplifier. Allowing for a reasonable reserve, it may be said that an output of 1 volt from the tape machine should be sufficient in virtually all situations. One volt should also be enough to drive a power amplifier directly, as is sometimes done, because most power amplifiers can be driven to full or very high output by 1 volt or less.

(If the playback signal is taken directly from the tape head, then one must look to the control amplifier rather than to the tape machine to assure there is sufficient gain. On signal peaks at 1000 cps, the tape head will produce roughly 5 millivolts or less on a half-track tape; and correspondingly less on a quarter-track tape. Thus at 1000 cycles the control amplifier should be capable of being driven to about 1 volt for a signal of about 2 millivolts from a tape head.)

### Adjustment Facilities

Every tape recorder should have means for readily adjusting the azimuth of the heads, so that the gaps are perpendicular to the length of the tape. This is commonly achieved by locating a spring under one or more of the head mounting screws, so that tightening or loosening the screws slightly will tilt the head about its vertical axis.

Adjustments for equalization, bias current, and calibration of the record-level meter are seldom found in machines of the home type, but are generally in-

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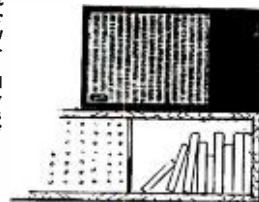
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corporated in the better grade machines associated with semi-professional and professional use. If a tape recorder is to be capable of consistently providing high-grade performance, then the following adjustments should be available.

1. *Playback Equalization.* At 15 and 7.5 ips (and perhaps at 3.75 ips as well), equalization of the playback amplifier should conform to the standard curve, which is NARTB at present. Equalization can be checked and adjusted on the basis of a series of frequencies fed into the amplifier from an audio oscillator or by playing a test tape. Some tape machines include compensation for treble losses due to the playback head. Many

or most playback heads used today have gaps sufficiently fine so that treble losses at 7.5 ips and higher speeds are negligible. On the other hand, as a playback head wears, its gap tends to widen and treble response to deteriorate. Thus an adjustment for frequency response at the very high end—above 10,000 cps or so—can prove useful. However, such equalization has limits. For one thing, after the gap widens to a certain extent, the drop in high-frequency response becomes too sharp to compensate satisfactorily. For another, excessive high-frequency boost in playback accentuates noise of the playback amplifier.

2. *Record Equalization.* Once play-

back equalization is adjusted to conform to the standard curve, then equalization of the record amplifier—in particular, treble boost—should be capable of adjustment to yield relatively flat response on a record-playback basis. Some machines incorporate two adjustments; one determines the maximum amount of treble boost, and the other the point at which treble boost commences. This permits very accurate shaping of the recording characteristic.

3. *Bias Current.* As pointed out earlier, the amount of bias current fed to the record head governs the amount of recorded distortion. Up to a point, an increase in bias reduces distortion. Before this point is reached, however, bias current causes severe high-frequency losses in recording. At 15 ips, one can usually adjust bias for minimum distortion without seriously affecting treble response, because the high-frequency losses become very severe *above* the audio range. But at 7.5 ips and lower speeds, these losses are severe *within* the audio range. Therefore at 7.5 ips and lower speeds, the bias setting is critical, being less than that which produces minimum distortion. One must make sacrifices both in distortion and in frequency response, and the problem is to find the optimum amount of bias that does not unduly sacrifice one performance characteristic for the sake of the other. Therefore the ability to adjust bias to the optimum level is important for the person desiring the best possible results. A previous article pointed out that tape machines which use a meter as a record-level indicator generally employ a switching arrangement so that the meter can be used to check whether bias is correct. Inasmuch as the proper amount of bias current will vary with tape speed, and even with brand or type of tape, it is desirable that the bias control be fairly accessible.

4. *Record-Level Indicator Calibration.* A high-quality machine will permit one to adjust the amount of signal fed to the record-level indicator so that it accurately indicates when the amount of signal fed to the tape produces a given amount of distortion—2% or 3% harmonic distortion usually being considered the maximum permissible amount.

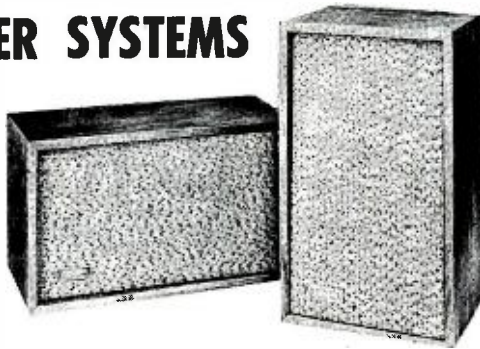
#### Bias Frequency

In order to avoid discernible beats between the bias frequency and harmonics of the audio frequencies, the bias frequency should be about four to five times the highest audio frequency, namely between 60,000 and 75,000 cps. While 75,000 cps or higher is even more desirable, a limit is set by the fact that capacitive losses in the record and erase heads increase with frequency. Accordingly, the bias oscillator has to work

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proportionately harder as bias frequency increases, which raises the problem of distortion in the bias waveform and attendant noise. Hence 75,000 cps or so is a practical maximum for the bias frequency. A frequency much below 60,000 cps is open to serious question as to its compatibility with high-fidelity performance.

#### A-B Switching

In a machine having separate record and playback heads, it is highly desirable that there be an A-B switching facility, as illustrated in Fig. 17, to permit comparison between the incoming signal and the signal recorded on the tape. Specifically, the output jack of the tape machine and the monitor jack should be switched between the incoming signal and the playback signal. Comparison between the two signals can then be made by earphones connected to the monitor jack or by means of a sound system fed from the output jack.

#### Record Interlock

One of the catastrophes that occasionally befalls the tape recordist is that of inadvertently erasing part or all of a valued tape because the machine is accidentally set in the record instead of playback mode. To minimize this danger, most tape machines provide a safety interlock that prevents putting the machine into record position unless one simultaneously actuates a special record button or lever. This button or lever should automatically disengage when the machine is put into any other mode of operation. To further minimize the danger of accidental erasure, some tape recorders have a warning light that goes on when the machine is in the record mode.

#### Automatic Equalization Change

It is desirable that the record equalization, and if necessary the playback equalization, be automatically changed when going from one tape speed to another.

#### Number of Motors

The transport has three basic mechanical functions so far as the record and playback modes are concerned: (1)

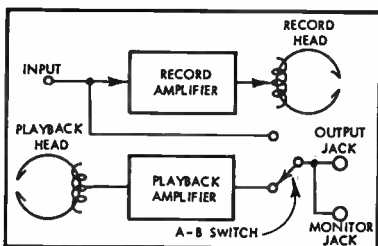
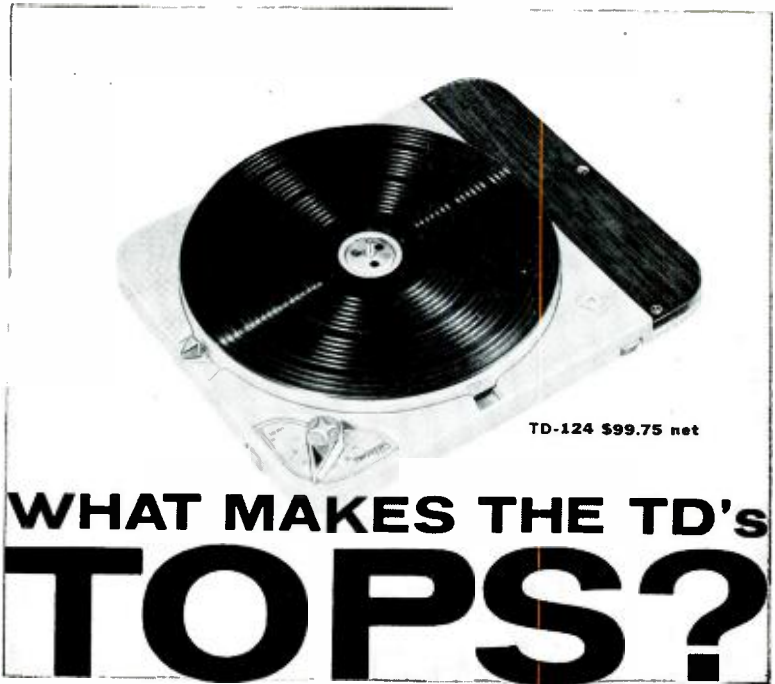


Fig. 17. A-B switching arrangement.



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after you've placed stylus, permits  $\frac{2}{3}$  rev. starts, makes cueing easy). • **Extremely low rumble** (mirror-finish main-bearing, nylon-seated ball-thrust-bearing reduce both vertical and horizontal rumble to a new low, so important for stereo). • **2-way motor rumble reduction** (both an extra-large idler and an ultra-compliant belt-drive keep motor vibration and speed variations from table). Driving parts electronically balanced. No costly base necessary (only \$9.00). 50/60 cycles, 100/250 volt operation.

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To turn the takeup reel in a given direction; (2) to cause the supply reel to *tend* to turn in the opposite direction so as to provide back tension on the tape; (3) to drive the capstan, which in conjunction with the pressure roller grips the tape and pays it out at a prescribed rate of speed. As a general rule, the best performance—most accurate speed and least wow and flutter—is achieved by transports having a separate motor for each function. On the other hand, there are a few single-motor transports that through excellent design and construction achieve results about as good.

#### Tape Handling

The speed, ease, and smoothness of tape handling are among the factors to be considered in acquiring a tape recorder. Starts and stops should be fast, but accomplished with sufficient smoothness to avoid breaking or stretching the tape. While some professional machines can come up to operating speed or to a full stop in as little as 0.1 second, as much as 1 second is usually adequate for home purposes.

A transport should be able to wind a 1200-foot reel of tape in either direction

in about 60 to 90 seconds; semi-professional and professional units require as little as 30 seconds. Smoothness of winding is of greater importance than speed, however, so one should not be overly distressed about a slow-winding machine provided that it winds uniformly. The slower the winding speed, the less the tendency to stretch the tape or generate stresses that can result in distortion. Some tape recordists, where utmost quality is sought, have been known to rewind a tape at operating speed by reversing the reels and putting the machine in the playback mode. If the winding speed varies according to the tape speed setting (7.5 ips, 3.75 ips, etc.), it may be advisable to rewind the tape in the slowest available speed.



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#### Tape Lift

To minimize head wear, which is due to abrasive action of the tape against the heads, it is desirable that the tape be automatically spaced away from the heads during rapid wind or rewind. In some machines, this spacing is deliberately kept small to permit a slight amount of signal pickup (chiefly low frequencies) to facilitate locating a desired passage on the tape.

#### Loading

Loading of the tape machine should be a simple, rapid procedure, without the tape having to be threaded through a complex system of guides, rollers, and so on. Most transports today feature "in-line" loading, where the tape is merely dropped in a straight or slightly curved slot and thereby properly engages the driving mechanism, heads, and so on. There are times when the operator will have to reload as rapidly as possible—for example, when taping a program off the air—and facile loading can then be a most important asset of a tape machine.

The purchaser will want to check that the tape path is such as not to skew the tape, but allow it to wind from one reel onto the other without scraping the top or bottom of either reel (assuming the reels are not warped). If the path causes the tape to skew, not only is there a disturbing noise as the tape scrapes the reel, but the azimuth relationship between the tape and heads may be affected.

#### Tape Index

To facilitate location of a passage on a tape, a tape index of some sort is desirable. Most transports at least provide markings under the reel to indicate elapsed time or remaining time at a given speed. In addition, a number incorporate a mechanical counter of one type or another. Some employ a clock-type dial and revolving hand. Others use rotating numbered discs.



### Editing Facilities

The serious recordist may be concerned with editing problems, where it is necessary to make splices at a given note or syllable. In this case, it is important to the recordist that the machine provide easy access to the tape when it is in front of the heads, so that he can mark the exact point on the tape where a splice is to be made.

### Controls

Push-button controls—either mechanical or employing solenoids—are found in many tape recorders, both of the home type and of professional grade. While they offer operating convenience compared with transports manually actuated by levers, on the other hand the more complex the mechanism the greater is the possibility of malfunction. Moreover, there is less "feel" to a machine with push-button control, and tape breakage or spillage may occur if the push-button mechanism functions improperly.  $\text{E}$

## BOOK REVIEW

**The Audio Cyclopedia**, by Howard M. Tremaine. 1280 pages, 6" x 9", 354 half-tone illustrations, 1300 line drawings. Indianapolis: Howard W. Sams & Co. \$19.95.

The first complete audio handbook has finally made its appearance. Said to have been eight years in preparation—which we can well believe—and two years of editing, *The Audio Cyclopedia* brings more than a wealth of information between its covers. Its 26 sections begin with the basic principles of sound and continue through acoustics, constant speed devices, components used in studio-type systems, amplifiers, disc recording and reproducing, magnetic and optical recording, motion picture projection equipment, loudspeakers, power supplies, test equipment, measurements, installation techniques, and general information. The obviously added-on last chapter, about disc stereo, is the only one not fully up to date.

The book is presented as a series of questions, with the text comprising the answers to them. This makes for an unusual style, but it appears to be as effective as the more common style, and at least more informal and therefore more readable.

Some 240 pages are devoted to test equipment and audio measurements—sections which in themselves would make a valuable and much-needed book if they were available alone. About 170 pages cover optical film recording and motion picture projection equipment—rather more than seems necessary since a relatively small number of people actually work at it. However, much of the basic audio engineering came from the motion picture studios, and the author has been in that line of work for most of the thirty years that this reviewer has known him.

Practically every subject we have looked up has been covered in this cyclopedia—which is more than can usually be said about most cyclopedia—and on those subjects with which we are familiar it appears that the information is adequate, correct, and well presented. We know of no other single source of so much audio information. —CGMeP

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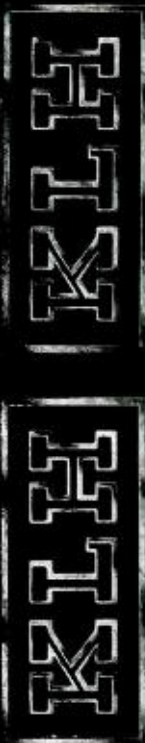
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# ABOUT MUSIC

HAROLD LAWRENCE\*  
Lofty Music in Paris

To the crew about to undertake a recording of the St. Sulpice organ, the most formidable impression made by this sprawling 18th century church is that of stairs. Stairs in front of the center portals, spiral stairs winding up toward the organ loft, perilously narrow wooden stairs going to the platform above the mighty instrument, and more stairs to the uppermost ramp of the interior of the church. The longest continuous stairway is the spiral one; taken at too fast a clip, this cork-screw-like ascent can set your head spinning by the time you reach the landing, and, if the steep climb does not make you dizzy, the view from the balcony down the full length of the church (some 400 feet) will do the job. From here, powerful Delacroix frescoes look down upon noble columns bathed in a topaz-colored light (the temporary yellow stained-glass windows are replacements for wartime casualties). The beauty of the proportions of the interior conveys a sense of repose and balance that is in marked contrast to the "exuberant decorative art of the lateral chapels, with their globe "clouds," cherubs, and concealed lighting. There is even a pair of gigantic Venetian shells in the aisles which are used as holy water vessels.

All these stairs are located in the south tower of the church, the focal point of the preparatory work involved in the recording. In the manner of an army about to storm the heights of a medieval fortress, the first order of the day was to explore the tower from ground to turret in order to discover the most convenient and shortest route for the audio cables. This, of course, was dictated by the placement of the microphones and the disposition of the playback room. Our guide for the investigation, M. Minard, the sacristan, brought with him a large batch of keys with which to open the numerous doors, gates and partitions as we proceeded mole-like through the dimly-lit passageways. Illumination was provided by means of a series of buttons found at regular intervals along the way. By pressing one of these, electric bulbs light up throughout the tower. An automatic timing device turns off all the lights every minute or so, however, and you are then thrown into a dungeon-black darkness. A stranger in the tower, not knowing where the next light button was located, would have to grope forward cautiously, and search along the walls with his hands for the button. At moments like these, it was reassuring to have Minard with us; he would tell us to "freeze" while he clattered on confidently to the next button.

Scores of steps later we found ourselves in a corridor leading to the organ loft. We passed a row of bellow-pedals, a carry-over from pre-automation days when the organ drew its breath from foot-operated bellows. To the right, a legend engraved in the wall listed the registration-stop pedigree of this mighty instrument, the largest on the Continent. At the end of the corridor is the organist's study, now occupied by Marcel Dupré who holds the coveted position of organist of St. Sulpice. Dupré's predecessors,

Charles-Marie Widor, held the post for no less than 64 years and, quite naturally, the little room is a tribute to his memory: there is an oil portrait of the late master as well as other memorabilia including his desk, furniture, and manuscripts. In its simplicity and lonely setting it has a strangely moving effect on the observer.

Above the organ loft, through another locked door, we reached as far as stairs could bring us, namely, to the upper ramp of the interior. After looking over the array of pewter-toned pipes from our vantage point, we calculated what the most practical microphone position would be; then we examined the walls of the church to locate a good rope-tying spot. (The railing along the ramp is precariously shaky.) Much to our delight, the 18th-century architects had thoughtfully included a pair of built-in iron rings in the walls on both sides of the organ. We therefore strung our rope and pulleys through the rings.

Now that we had decided on an over-all microphone setup, the next plan of action was to locate the monitor room. This proved to be a more difficult undertaking. In terms of access to the console, there was, of course, the organist's study behind the organ loft; but this was rejected because of the size: it was large enough to accommodate the three speakers, all right, but no personnel. The sacristan then suggested the ground floor chapel of the south tower which is in use only once a week. But that would have made it necessary for M. Dupré to climb the equivalent of seven stories in order to go from console to monitor room each time he wanted to hear a playback. At this point, Minard recalled that there was a chapel (now abandoned) not far from the organ loft, on a slightly higher level. Up we went again. Opening a door behind the organ pipes, we ascended a narrow wooden staircase, pushed open a trap door, climbed a few stairs, and there we were. Nothing remained of the chapel except a statue of the Madonna. The rest of the long room contained chunks of crumbling masonry, an oil canvas lying beneath a pile of broken straw chairs, several empty beer bottles, and some 1937 newspapers. Apparently the chapel had been used as a recreation room for construction workers during a period of church repairs. We learned later that students' mass was celebrated here many years ago. When we told Dupré that we were going to utilize the old chapel as our playback room, he told us that he attended Sunday mass there as a boy. We invited him to look in and see whether he thought it would be suitable for him, and he directed us toward another door—the wrong door. He had forgotten the way over the years. Entering the chapel with us, he paused and looked at the ruined interior with tears welling up in his eyes: "Tiens," he said, "Just think, it's been 50 years since I last set foot in this place!"

It was decided to use one end of the chapel as the playback area since it was more or less separated from the main part of the room. The lack of furniture and illumination was dealt with in a crude but

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

effective manner: two battered chairs placed at a wide interval supported a long wooden plank, nail-studded and bristling with splinters; this constituted the worktable for the A. & R. department. For light, a dormant electrical outlet was discovered and put into service by an enterprising engineer. The chapel, incidentally, became the assembly point for the monitor, microphone and intercom cables which had been hauled up the façade of the church from the recording truck below.

The object of all this activity was to capture on magnetic tape the sound of a renowned instrument performed by an artist who is thoroughly familiar with all its resources and capabilities. Of the latter, the St. Sulpice organ is richly endowed. Built by Cavallé-Col during the last century, it is a product of the golden age of French organ building. As in the churches of Sacré-Coeur and Ste. Clothilde, Cavallé-Col achieved here a remarkable degree of purity of timbre. While his St. Sulpice organ is admirably suited to the fullblown Romantic works of Widor, it nevertheless does justice to Bach and Couperin because the contrapuntal voices are projected without blurring or rumbling.

The first test recordings were made before midnight early last June. The church was empty and the old district of St. Sulpice was as quiet as a provincial village at night except for the distant bustle of nearby Boulevards Raspail and St. Germain. Suddenly, the sound of this glorious instrument rolled into the star-filled Parisian night and echoed through the Place St. Sulpice and the streets leading into the square. Transfixed by the music, a lone bicyclist stopped to listen. It seemed as if the whole quartier joined with him. **Æ**

## COMING HI-FI SHOWS

Sept. 11-13—Milwaukee, Pfister Hotel. (Rigo)

Sept. 18-20—Chicago, 8th Annual High Fidelity Show and Music Festival, Palmer House, (International Sight and Sound Exposition, Inc.)

Sept. 25-27—Rochester, N. Y., Sheraton Hotel. (Rigo)

Oct. 5-10—New York, High Fidelity Music Show, New York Trade Show Building. Presented by the Institute of High Fidelity Manufacturers, with "Decorate your home with music" as the theme. (IHFM)

Oct. 30-Nov. 1—Buffalo, N. Y., Statler Hotel. (Rigo)

Nov. 6-8—Seattle, Wash., New Washington Hotel. (Rigo)

Nov. 13-15—Portland, Ore., New Heathman Hotel. (Rigo)

Nov. 20-22—Philadelphia, Benjamin Franklin Hotel. (Rigo)

Jan. 27-31—San Francisco, Brooks Hall. (IHFM)

Feb. 10-14—Los Angeles, Shrine Exposition Hall. (IHFM)

AUDIO • AUGUST, 1959



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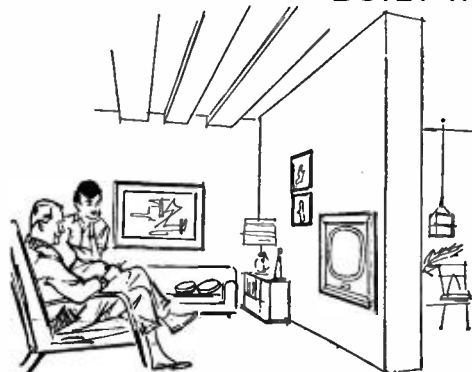
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**ENGINEERS' ERRORS**

(from page 56)

by the law. In a suit against engineers a judgment was recovered against them which they appealed. In affirming that judgment the South Carolina court stated a rule of law that is fundamental in the determination of the liability of engineers for mistakes of this character.

"It seems to be well settled," said that court, "that where a person holds himself out as specially qualified to perform work of a particular character, there is an implied warranty that the work which he undertakes shall be of proper workmanship and reasonable fitness for its intended use and if a party furnishes specifications and plans for a contractor to follow, he thereby warrants their sufficiency for the purpose in view."<sup>6</sup>

Recently in Virginia the defense to a suit for the foreclosure of a mechanic's lien for architect's services involved the same principles of law applicable to the services of engineers. By the owner it was contended that the work had been faulty and the cause of a loss.

**Obligations Limited**

There the Virginia court outlined the extent of these obligations imposed by the law on engineers, architects and other professional workers. "The owner earnestly argues," said that court, "that it has suffered great loss as the result of the defects due to the failure of the architect to execute proper and sufficient plans and specifications.

"The architect in the preparation of plans and drawings owes to his employer the duty to exercise his skill and ability, his judgment and taste, reasonably and without neglect. In his contract of employment he implies that he possesses the necessary competency and ability to enable him to furnish plans and specifications with a reasonable degree of technical skill.

"He must possess and exercise the care of those ordinarily skilled in the business and in the absence of a special agreement, he is not liable for fault in construction resulting from defects in the plans, because he does not imply or guarantee a perfect plan or a satisfactory result."<sup>7</sup>

A decision frequently adopted by the courts as an authority in these controversies involving the liability arising from the performance of services by engineers and other professional workers was rendered by the Maine Supreme Court in the last decade of the past

<sup>6</sup> Hill v. Polar Pantries, 64 S.E.2d 885, South Carolina, April 30, 1951

<sup>7</sup> Surf Realty Corp. v. Standing, 78 S.E. 2d 901, Virginia November 30, 1953

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century. There suit had been brought for professional services and the defense interposed was that the services were not of benefit to the owner although no imputation was made of either negligence or bad faith in the performance of the work.

Granting a new trial to this professional worker who had been met with an adverse decision in the lower court, this appellate court said of the law governing engineering and other professional workers,

"The responsibility is essentially the same as that which rests upon the lawyer to his client, or upon a physician to his patient or which rests upon anyone to another where such person pretends to possess some skill and ability in some special employment and offers his services to the public on account of his fitness to act in the line of business for which he may be employed.

"The undertaking of an architect implies that he possesses skill and ability sufficient to enable him to perform the required services at least ordinarily and reasonably well and that he will exercise and apply in the given case his skill and ability, his judgment and taste, reasonably and without neglect."

To this rule however the court set out an all important exception. "But the undertaking," said the court, "does not imply or warrant a satisfactory result. It will be enough that any failure shall not be by the fault of the architect. There is no implied promise that miscalculations may not occur.

"An error of judgment is not necessarily evidence of a want of skill or care, for miscalculations are incident to all the business of life." To this is added an outline of the duties of the professional worker and the principle of law governing all professional services of this character.

"Those who employ him have a right to his best judgment, to his skill, to his advice, to consultations with him and to his absolute fidelity and good faith and when he has contributed these things to the person who employs him, his duty has been fulfilled."<sup>8</sup>

**"Ordinary Care and Diligence," not a Guarantee**

In another instance involving this same feature, the obligations and liabilities of engineers and other professional workers, a New England court a hundred years ago said of the rule of law at that time which still subsists,

"The professional man contracts that he will use reasonable and ordinary care and diligence in the exertion of his skill and the application of his knowledge to

<sup>8</sup> Coombs v. Beede, 36 Atl. 104, Maine, May 7, 1896

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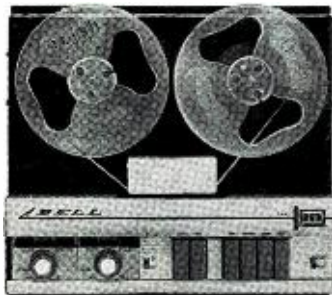
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<sup>9</sup> Leighton v. Sargent, 27 N.H. 460, December, 1853

**JAZZ**

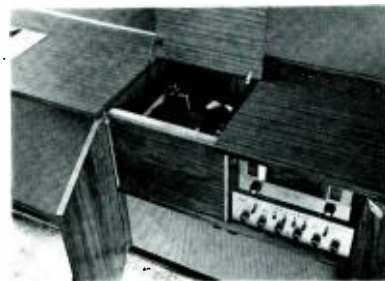
(from page 91)

gress and the United Nations. His first recording is well executed, with an assist from several of El-Bakkar's musicians, and should win him many friends.

On a visit to the night clubs of Lebanon's capitol city, the women take over. Of the seven vocalists heard during the evening, only one is a man and he has a female accomplice. The tour, recorded on the spot, is a lively one and encompasses an engaging variety of style and accompaniments. Again a Western influence crops up, but is soon subdued in a welter of Oriental melodies.

**COVER PHOTO**

The installation shown on the front cover of this issue is obviously designed to be "lived with." Not garish in appearance, but simply neat and efficient throughout, it incorporates a Fisher 90X FM tuner with space provided for a multiplex adapter, a Fisher 400 stereo preamplifier, two Leak L50-plus 50-watt amplifiers, two Bozak 305 speaker systems in custom enclosures, a Garrard RC98 record changer with a Pickering 371D cartridge, and an Andrea TV set. There is a KLH Model Six as an auxiliary speaker on the adjacent sun porch with a volume control at the listening position.



The heat duct along the back of the cabinetry acts as a chimney and there are aluminum deflectors to conduct heat to back and up. Slots are located on the toe plate below the cabinets for ventilation when the doors are closed. The grill cloth below the controls provides ventilation for the power amplifiers, and is removable for servicing.

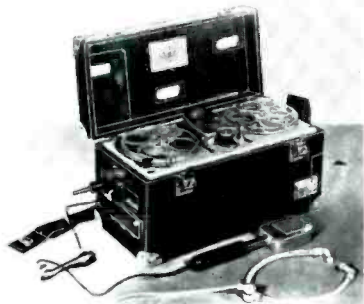
The room is fully carpeted and has one fully draped wall in addition to a partially draped wall opposite the unit. One wall, adjacent to the record cabinet of the unit, is walnut paneled.



## PRODUCT REVIEW

(from page 82)

utes. Frequency response at 15 ips is within  $\pm 2$  db of the level at 1000 cps, between 50 and 7000 cps, and within  $\pm 3$  db from 7000 to 10,000 cps. The signal-to-noise ratio is better than 45 db unweighted at 1000 cps. Separate recording and playback heads and



amplifiers are provided to facilitate monitoring and instantaneous playback. Manufactured by Electrical & Musical Industries, Ltd., of England, the E.M.I. portable recorder is distributed in the United States by Ercona Corporation, 16 W. 46th St., New York 36, N.Y. User net price, \$395.00.

## MAGNECORD

• *Stereo Magnecordette.* The Series 100 Magnecordette is a portable professional-type tape recorder which both records and plays back in-line stereo. A two-speed machine, operating at  $7\frac{1}{2}$  and  $3\frac{3}{4}$  ips, it is also capable of standard monophonic recording and playback when desired. Separate VU meters and gain controls are incorporated for each channel, as well as a master gain control which operates on both channels simultaneously. Frequency response is 40 to 15,000 cps  $\pm 2.0$  db at  $7\frac{1}{2}$  ips; 50 to 7500  $\pm 2$  db at  $3\frac{3}{4}$  ips. Inputs are provided for two high-impedance



microphones, also for auxiliary devices such as tuners, phono cartridges, etc. Two-motor drive system holds flutter and wow to less than 0.3 per cent. Noise level is down more than 48 db. Binaural monitoring is accomplished by means of a panel-mounted phone jack. Playback outputs are cathode followers which deliver 1.0 volt from normal output level. This is truly a fine instrument for the serious hobbyist who demands a high measure of audio quality as well as dependability of performance. Magnecord Division, Midwestern Instruments, Inc., 41st St. and Sheridan Road, Tulsa, Okla. User net price, in portable carrying case, \$449.95.

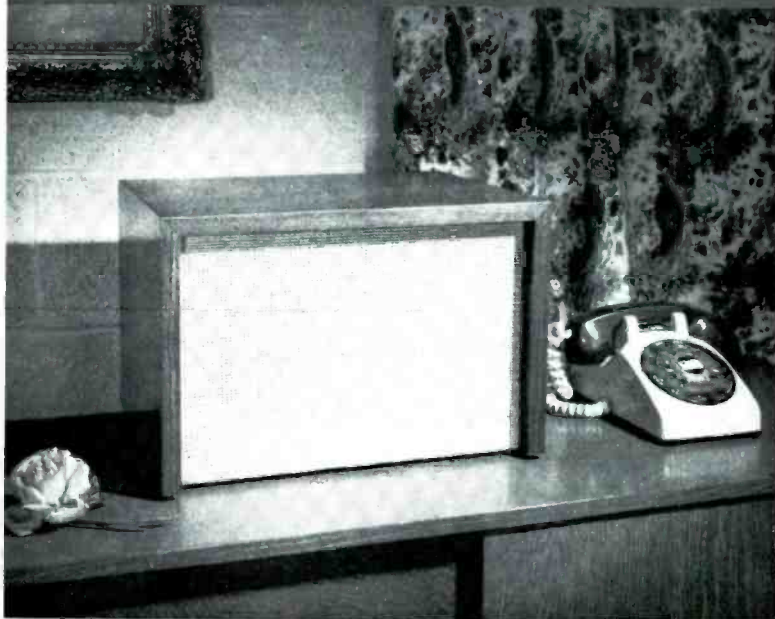
PT6-6A 2sp, full/1/2tr, rec/pb, port \$405.00  
PT6-6J rec/pb ampl, port ..... 295.00

AUDIO • AUGUST, 1959

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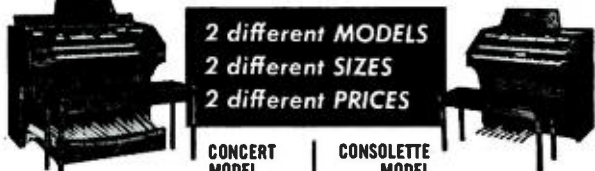
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Circle 106 B



**MAGNEMITE**

● **Battery-Operated Spring-Motor Tape Recorder.** Accuracy and simplicity of operation are stressed in the design of the VU Magne-mite portable tape recorder. Professional performance is provided by the incorporation of a VU meter to act as a recording and output-level indicator and "A" and "B" battery voltmeter. Special ballistic characteristics are incorporated in the meter to ensure avoidance of overload of peak signals. Shunting of the output signal during recording is avoided by employing an isolating amplifier. The VU model is similar to other Magne-mites in general characteristics. It is available with operating speeds ranging from 15/16 to 15 ips. Frequency ranges run from 300-2500 cps to 50-15,000 cps, depending on operating speed. At 15 ips the machine meets primary NARTB standards. Because this recorder is primarily a professional instrument, available for a wide range of specific uses calling for various accessories, it is suggested that interested readers get in touch with the manufacturer for exact price information. Amplifier Corp. of America, 398 Broadway, New York 13, N.Y. User net price, 7 1/2-ips twin-track model, \$365.00.

**NEWCOMB**

● **Stereo Tape Recorder.** The Newcomb Model SM-310 is a rugged, simple, foolproof instrument with the precision and dependability required by the professional, combined with the straightforward operation desired by the serious amateur. Transport control is centered in a "joy stick" with completely logical positioning—fast forward (3600 feet in two minutes), right; rewind, left; record or playback, down. Partial stick movement gives slower reel speed. An edit position permits turning reels by hand. The SM-310 is a two-speed (7 1/2 and 3 3/4 ips), two-channel machine for either stereophonic or half-track monophonic recording as well as playback. Two inputs with mixing controls are provided for each channel, also two illuminated VU meters. Handles reels of any size up to 10 1/2 in., including NARTB hubs. Tape drive is by means of a single powerful fully-synchronous cool-running motor. Frequency response is 30 to 15,000 cps ± 2.0 db at 7 1/2 ips; less than 0.25 per cent at 3 3/4 ips. Equalization is NARTB standard. Output is approximately 1.3 volts from cathode follower, each channel. The SM-310 is an ideal instrument for the individual who is deep in the art of tape recording. Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood 38, Calif. User net price, including case, \$499.50.

N-64c Uni-dir dyn mic, w/cord, plug... \$60.00  
N-36c Slim omni-dir dyn mic, w/cord, plug... \$1.60



**AUDIO • AUGUST, 1959**



New  
PROFESSIONAL 55  
the Ultimate  
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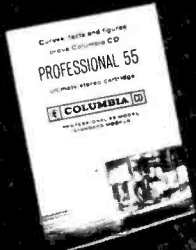


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Circle 107A

**NORELCO**

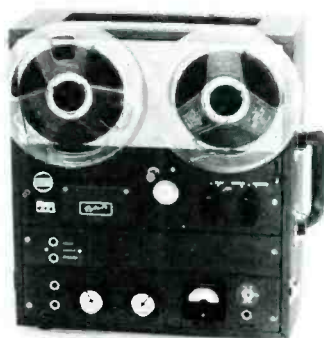
• *Stereo Tape Recorder.* Engineered and manufactured by Philips of The Netherlands, the new Continental "400" features half-track stereo playback and quarter-track stereo and monophonic record and playback for tape economy. Three speeds—7½, 3¾ and 1½ ips—for versatility, and simple piano-key controls for ease of operation. It is fully compatible with conventional recorded tapes. The unit comprises a tape-drive mechanism, two preamplifiers with controls, two 4-watt power amplifiers, and a Norelco wide-range speaker, all housed in a high-fashion portable carry-



ing case. Also furnished is a Norelco dynamic stereo (dual element) microphone. Only a second speaker is needed for stereo playback. Dubbing facilities permit recording sound on sound. The Continental 400 has inputs for recording from microphone, tuners, and phonograph, with facilities for mixing the microphone input with either of the other two. An output jack for monitoring with stereo headphones is also provided. Special Philips magnetic heads with a gap of only 0.00015 in. make possible extended high-frequency response even at lower recording speeds. Frequency ranges at the various speeds are: 7½ ips—50 to 18,000 cps; 3¾ ips—60 to 14,000 cps; 1½ ips—60 to 7000 cps. Noise level is down 55 db, and flutter and wow are less than 0.3 per cent. High Fidelity Products Division, North American Philips Company, Inc., Hicksville, N.Y. User net price, \$399.50.

**ROBERTS**

• *Monophonic Tape Recorder.* The new Roberts Model 191 is a full-track monophonic recorder of special interest to radio and TV stations, sound engineers and recording studios. A two-speed recorder, it meets professional specifications, having a frequency range of 40 to 15,000 cps ± 2.0 db at 7½ ips, and 40 to 9500 cps

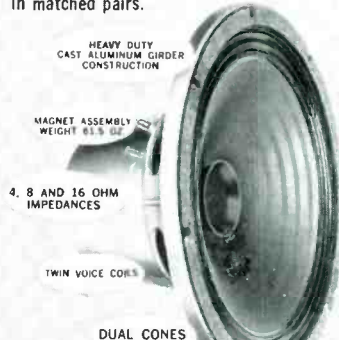


± 3.0 db at 3¾ ips. Flutter and wow content is less than 0.2 per cent rms. Noise is 55 db below recorded zero level. The hysteresis-synchronous drive motor is belt-coupled to a speed-stabilized flywheel/capstan assembly. The amplifier features professional-type terminal board wiring and has 6 watts output for feeding the built-in playback speaker. High-impedance preamp output is also supplied for feeding external equipment. Equalization is based on NARTB standards. VU meter is

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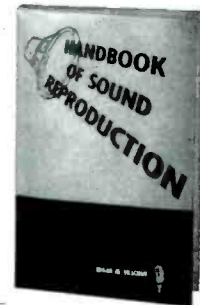
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### No. 115 McPROUD HIGH FIDELITY OMNIBOOK

Prepared and edited by C. G. McProud, publisher of Audio and noted authority and pioneer in the field of high fidelity. Contains a wealth of ideas, how to's, what to's and when to's, written so plainly that both engineer and layman can appreciate its valuable content. Covers planning, problems with decoration, cabinets and building hi-fi furniture. A perfect guide. \$2.50 Postpaid.



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### NEW! How-to Book on Hi-Fi Repair CARE AND REPAIR OF HI-FI—Volume I

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calibrated from -10 to +3 db. Interlocking controls prevent accidental erasure of recorded tapes. Notwithstanding the fact that it is a complete record/playback system, the 191 measures only 15 3/4" h x 14 1/2" w x 9 1/4" d, and weighs but 28 lbs. Roberts Electronics, Inc., 1041 N. Sycamore St., Los Angeles 38, Calif. User net price, \$325.00.

## SUPERSCOPE

● *Stereo Recorder-Playback System.* Everything required for stereo recording and playback, including two VU meters and two power amplifiers, is incorporated in the Sony "Sterecorder." A precision-built instrument in all respects, it incorporates a hysteresis-synchronous drive motor and affords instant selection of 7 1/2- and 3 3/4-ips drive speeds. Frequency response is 50 to 15,000 cps ± 2.0 db at 7 1/2 ips; 30 to 12,000 cps at 3 3/4 ips. Flutter and wow components are less than 0.2 per cent



and 0.3 per cent at the higher and lower speeds, respectively. Stacked high-frequency erase head erases both channels when recording stereo, or one channel (half track) when recording monophonically. Individual level control is afforded for each channel, plus master gain control for simultaneous adjustment. Automatic head-demagnetizing circuit prevents residual magnetism, with resultant minimum tape hiss. Automatic tape lifters protect recording heads and tape during fast forward and rewind. Designed for both custom installation and portable use, the Sterecorder will satisfy the most fastidious user. Superscope, Inc., Sun Valley, Calif. User net price, \$395.00. *Note:* A wide range of accessories is available for use with the Sterecorder, and it is suggested that those interested in purchasing one write for descriptive material.

## TANDBERG

● *Stereo Record-Playback System.* Notwithstanding its compactness, the Tandberg Model 5-2 performs virtually every task which could be expected of a modern tape recorder. A 3-speed machine (7 1/2, 3 3/4 and 1 1/2 ips), it has facilities for 4-track stereo and monophonic recording and playback, playback of 2-track stereo, and playback of half-track and quarter-track monophonic tape. The unique 4-track in-line precision laminar head has double mu-metal shielding to give crosstalk rejection of 60 db. Frequency response (NARTB equal-



ization) is 30 to 20,000 cps at 7 1/2 ips; 30 to 16,000 at 3 3/4 ips, and 30 to 8000 cps at 1 1/2 ips. Flutter and wow are 0.1, 0.2, and 0.25 per cent at the three respective speeds. A powerful motor of the capacitor-starting type assures uniform speed over a range of line voltages from 90 to 135 volts. The erase head is selective and may be used to erase any one of the four tracks individually. An automatic tape-stop switch stops tape with metallized leader at end of reel. Tandberg of America, Inc., 8 Third Ave., Pelham, New York. User net price, as shown but with second-channel recording amplifier mounted in an auxiliary matching mini-case, \$489.50.

## TELECTRO

● *Series 900 Tape Decks and TRP-11 Record/Play Amplifier.* The Series 900 offers a variety of facilities in a simple tape-transport mechanism without electronic equipment. For those who wish a complete recording system, including record and play amplifiers and the necessary bias oscillators, the Telectro line includes the Model TRP-11 record/play preamplifier, which provides for recording from low-level microphone input or from a high-level source such as a tuner, and in the play mode has an output of approximately 5.0 volts. Controls on the TRP-11 include a record/play selector, equalization switch, noise balance, and gain control. Recording level is shown by a VU meter. The tape transport itself is available in five forms, depending on the head complement. Model 900-1 is equipped for monophonic recording and playback and for 2- or 4-track stereo playback; 900-2 has three heads—monophonic erase and play/record heads, and a 4-track stereo head which may be used as a monitor during monophonic recording, or for playing back both 2- and



4-track stereo tapes; 900-3 has two heads, stereo erase and 4-track record/play; 900-4 is equipped only for playback, and has a single 4-track head which will play mono and stereo tapes; 900-5 has three stereo heads, making it possible to monitor a tape during recording. All models are for 3-speed operation—7 1/2, 3 3/4 and 1 1/2 ips. Flutter and wow content is less than 0.25 per cent. Signal-to-noise ratio is better than 50 db when used with the TRP-11. Speed accuracy is within NARTB standards. The mechanism employs a single motor with belt drive to the reel hubs and to the capstan, the latter having a large flywheel for speed stability. Transport controls are push-button operated. They include: stop, rewind, wind, play, and pause. The TRP-11 incorporates a VU meter. Frequency response is 50 to 15,000 cps ± 3.0 db. Inputs are supplied for a low-level microphone and high-level tuner, with maximum recording level sensitivity of 0.002 volt. Telectrosonic Corporation, 35-18 37th St., Long Island City, N. Y. User net price: Model 900-1 tape transport, \$89.95; 900-2, \$104.00; 900-3, \$101.00; 900-4, \$89.95; 900-5, \$126.25. Model TRP-11 record-play preamplifier, \$65.00.

## UHER

● *Multi-use Tape Recorder.* A compact and ideal tape recorder for most tape applications excepting those where a maximum frequency range is required for high fidelity uses, the Uher Universal offers facilities not duplicated with most other machines. With three tape speeds—3 3/4, 1 1/2, and 15/16 ips—the Uher is



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sufficiently flexible to serve as a dictating machine at the lowest and as a conventional music recorder at the highest, where the frequency range is said to be 40 to 16,000 cps. Remote-control unit and Synchro-Akustomat—a device for actuating an automatic slide changer by means of a recorded tone signal—are available accessories, and the unit is provided in a travel-style case which accommodates microphone, cables, and tape supply. Hysteresis synchronous motor, self-contained speaker system, separate recording and playback volume controls, and many other useful and desirable features. Made in Western Germany, the Uher is distributed in the U.S. solely by Warren Weiss, c/o Trans-World Electronics, Inc., 1650 Broadway, New York 19, N. Y. User net price, \$299.95.

## VIKING

● *Two-Speed Stereo Recorder-Playback.* The recorder illustrated comprises the Viking Series 85 tape deck, and two Model RP62C record/playback preamplifiers, mounted in a Model W4SX enclosure. The 85 is the finest Viking deck designed for the home music system. Containing two motors—one for record, the other for rewind, fast forward and footage counter—it uses a dual concentric switch knob to control all mechanical operation. The inner knob controls forward, stop,

and edit functions, while the outer ring controls fast-forward and rewind. Universal head-mounting bracket on all decks comprising the Series 85 permits changing or adding to head complement at will. All models are equipped with long-wearing laminated heads, tape lifters, non-resonant pressure pads, and automatic tape run-out switch. The transport may be operated horizontally or vertically. Frequency response is 30 to 14,000 cps  $\pm$  3.0 db. Signal-to-noise ratio is better than 55 db. Flutter is less than 0.2 per cent at 7 1/2 ips. Front panel speed change, 3% and 7 1/2 ips. The RP62C record/playback preamplifier is engineered to match the operating characteristics of the Series 85 deck. Bias oscillators may be synchronized for stereo recording.

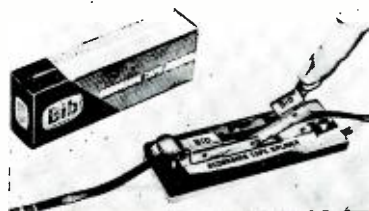


Erase current and bias are adjustable. NARTB tape equalization is fixed in recording, variable in playback. Distortion is less than 1.0 per cent at indicated normal recording level. The W4SX enclosure, available in polished walnut or fruitwood, accommodates the 85 Series tape deck and two vertically-mounted RP62C's. The bottom panel is removable for installation of power amplifier(s) or mixer controls. Viking of Minneapolis, Inc., 9600 Aldrich Ave., South, Minneapolis, Minn. User net prices: Model S5ES tape transport equipped for monophonic and stereo record/playback-erase, \$147.00. Model RP62C record/playback preamplifier, \$77.50. Model W4SX cabinet, \$39.50.

## Tape Accessories

### ERCONA

● *Tape Splicer.* An indispensable accessory for any tape recordist, this new British-made splicer is extremely simple to use and can be employed both for mending broken tapes and for editing purposes. Made of nickel-



plated brass, the B1B splicer comes mounted on a flock-sprayed base, or can be mounted directly on any tape deck. The body of the splicer has two pivoted clamps which lock the tape sections in a channel. Both vertical and diagonal mitres are provided for either editing or mending. Horizontal mitres are also provided for use in trimming off surplus mending tape. Distributed in the United States by Ercona Corporation, 16 W. 46th St., New York 36, N. Y. User net price, \$3.95.

### IRISH

● *Tape Stroboscope.* Shown checking the speed of an Ampex 601 is the Irish tape stroboscope, a device consisting of a handle and a Bakelite disc marked off in three concentric rings of radiating lines, with each ring representing a nominal tape speed. The

unit functions precisely as does a turntable strobe disc. To use the Irish stroboscope, the user holds it lightly but firmly against the surface of the moving tape. Extremely low-friction needle bearings allow the disc to revolve freely in correspondence with the tape



motion. Accurately scaled and ruled, one of these devices should be included in the gear of every serious tape recordist. ORRadio Industries, Inc., Shamrock Circle, Opelika, Ala. User net price, \$4.95.

### ROBINS

● *Bulk Tape Eraser.* This device is for the serious recordist who wishes to lower the noise level on tape to a degree greater than is possible with the average home tape recorder, also for those persons who wish to save the time normally consumed by running tape from reel to reel over an erase head. The Robins Model 99 will erase a full reel of tape in a matter of moments. By simply placing a





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**ROBINS ME-99 MAGNETIC BULK ERASER**

Improve your tape recordings by removing completely recorded and unwanted signals. The ME-99 reduces background noise levels of tape from 3 to 6 db below normal erase head level. If your tape deck is geared to stereo and does not have stereo erase, the ME-99 does the job quickly and eliminates sending tape through single-track erase head twice. In a matter of seconds it demagnetizes tapes up to 1/2 inch wide accepts reels up to 10".



**ROBINS TAPE HEAD DEMAGNETIZER  
MODEL HD-6**

Removes any residual permanent magnetism from your recording head thus eliminating high noise level and harmonic distortion caused by magnetism. Protects your tapes and your head and assures professional recordings. An extended pole-piece provides easy access to the heads of all leading makes of tape recorders.



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Upgrade your present recorder, convert to stereo with these precision magnetic recording and erase heads. Consider Model 5Q8, a 1/4 track stereo record/playback head, precisely engineered for conversion of many popular tape recorders. Note these quality features: exclusive "golden gap" of 80 microinches for performance at 3 3/4 IPS., 1/2 track approaching performance at 7 1/2 IPS., 1/2 track; flush shield construction for greatest hum rejection and less pole piece wear; crosstalk figure of merit: 50 db or better; colinearity and straightness of gaps: within 5 millionths of an inch. \$30.00 list.

Also available: Model 9QE3 — 1/4 track erase head. \$14.00 list. Tell us what model you have, and we'll let you know what head will modernize or convert your recorder to stereo.



Robins Tape and Record Care Accessories are available at high fidelity dealers everywhere, or write for FREE catalog.

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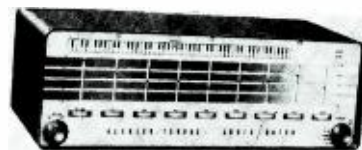
reel on the spindle and rotating it, the recordist immediately erases the signal, lowering the background noise level by 3 to 6 db below average erase head levels. It can handle reels up to 10 ins. in diameter, and erases tapes up to one-half inch wide. It operates on ordinary 117-volt 50/60-cycle house current. Robins Industries Corporation, 36-27 Prince St., Flushing, N. Y. List price, \$33.00.

ESK series Rec care kits ..... \$2.00-5.00  
"Gibson Girl" tape care kit ..... 3.50

**Miscellaneous**

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• **Record Handler.** Especially designed to prevent damage to records during handling, the Clarovox "Miragrip" enables any record to be picked up with ease and firmly held without leaving visible or audible marks, and with no danger of slipping. The pliers-like design is such that the Miragrip can be conveniently used with one hand, as negligible effort is needed to hold the record absolutely firm. The metal handles are chrome-plated and the rubber gripping sleeves are available in a variety of colors. The Miragrip is manufactured by Clarovox Products of Coventry, Eng., and is distributed exclusively in the United States by Ercona Corporation, 16 W. 46th St., New York 36, N. Y. User net price, \$4.95.



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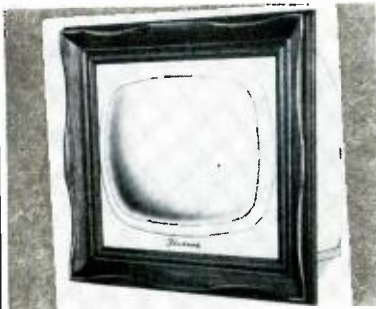
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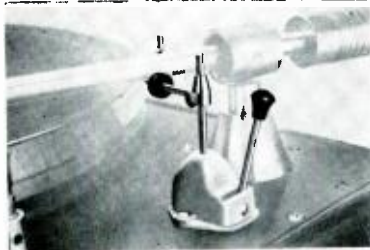
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• **High Quality TV Chassis.** The Fleetwood "da Vinci" is a wall- or bookshelf-mounting 21-in. TV receiver with remarkable audio and visual performance. It is designed to permit picture framing. Installed in a wall the da Vinci takes on the appearance of any picture one might choose to hang in the home. The Fleetwood remote-control tuning unit provides, at viewing distance, every control necessary for tuning television—on/off/volume, channel selector/fine tuning, brightness, contrast, and definition. Separate cathode followers are provided for audio and video circuits. Supplied with 40 feet of cable, the remote unit may be used at any practical distance from the receiver. The Fleetwood da Vinci uses a special 21-in. 110-deg. short-neck picture tube which permits an over-all set depth of only 14 ins. A high-fidelity audio channel affords faithful reproduction of the TV FM-sound transmission. Two separate audio outputs are provided—one for connection to a loudspeaker, the other for connection to a high-fidelity music system. Conrac, Inc., Glendora, Calif. User net price, including 21-in. picture tube and remote control unit, \$399.00

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**WANTED:** Presto 16-ohm 1-D disc cutters. State condition and best price. 612 40th St., N.E., Cedar Rapids, Iowa.

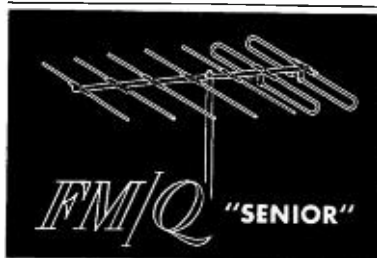
**FOR SALE:** Pilot AA-903 amplifier and preamp and Garrard RC-80 changer with G. E. magnetic cartridge (diamond stylus) and Formica base, \$60 plus shipping. AUDIO, Box CH-1, P. O. Box 629, Mineola, N. Y.

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junction with high-fidelity turntables. It is also useful with changers where it is desired to use the tone arm manually. Dextrafix acts as a safeguard against tone arm accidents which ordinarily result in damage to records, stylus and cartridge. It is used to lower the cartridge into the record lead-in groove gently and accurately. At the end of play, or at any desired point on the record, it may be used to lift the stylus. The stylus cannot touch the record or table until the lift bar is lowered for the next play. Installation can be made in minutes. The Dextrafix is a most useful device, affording music lovers the same means for preserving their records employed by most broadcast stations. Dexter Chemical Corporation, 845 Edgewater Road, New York, N. Y. User net price, \$4.95.

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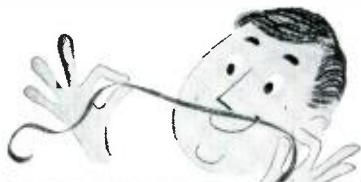


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Checks for: • *Head Alignment* • *Head wear* • *Track placement and balance*



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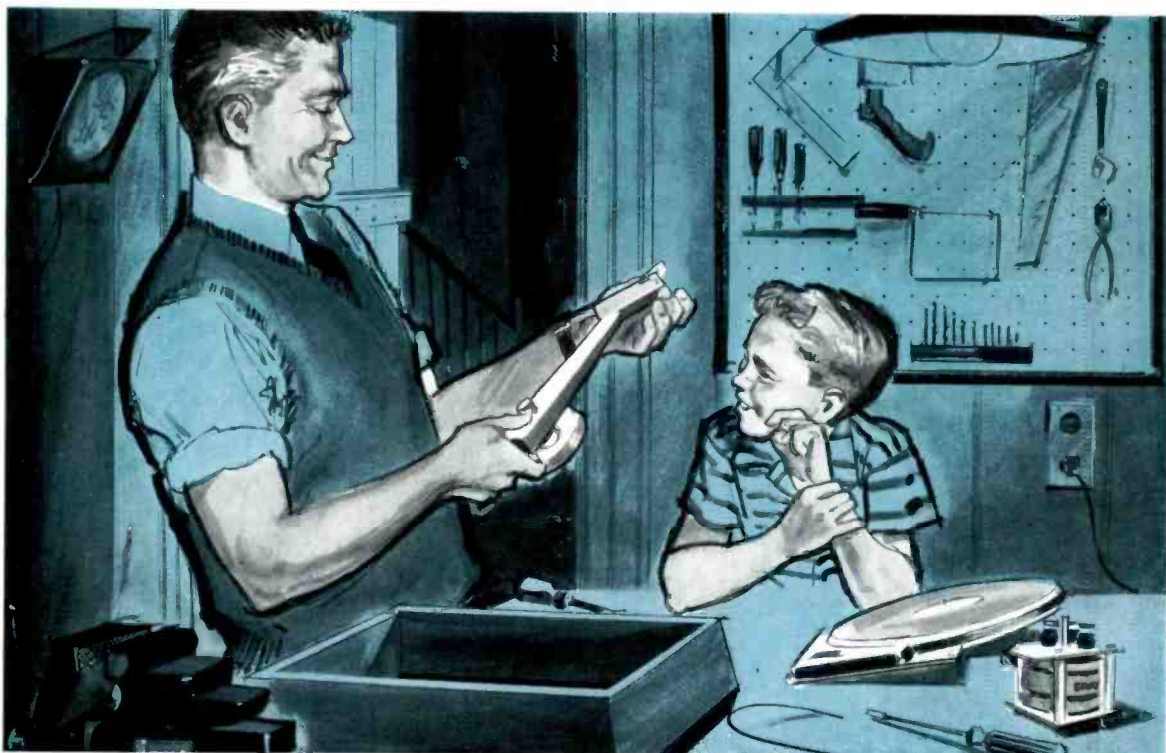
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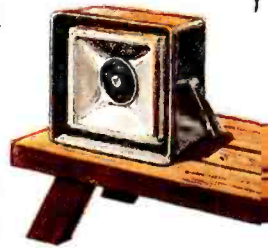


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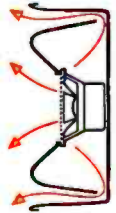
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