The Authoritative Magazine About High Fidelity

AUDIO

FEBRUARY
1970
60¢

MAHLER AT LENGTH *by Canby*

Transient Response of a Stereo Amplifier ▪

Negative Feedback ▪ Other Regular Features ▪

Classical Record Reviews ▪ Jazz ▪ Light Listening

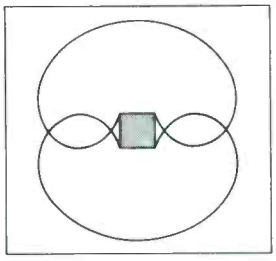
Where do you put Scott Quadrant Speakers?

Anywhere!

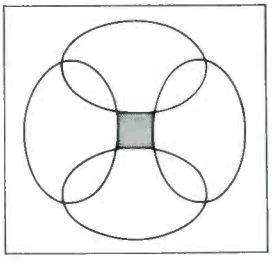
Speaker placement used to be extremely critical if you wanted to get the optimum stereo effect. But not any more. With Scott's new Quadrant Q-100 Speaker*, you can forget about placement problems. Quadrant speakers have been specifically designed to eliminate the "hole-in-the-middle" effect that plagues conventional speakers' stereo performance. Quadrant speakers have been used, with sensational results, in actual press demonstrations of 4-channel stereo, where the use of conventional speakers results in multiple "holes-in-the-middle."

Here's how the Quadrant idea works: two woofers radiating more than 180° each and four midrange/tweeters radiating more than 90° each are placed around the four sides of the Quadrant speaker. They project full-frequency sound in a complete circle. The sound is radiated both directly at you and in all directions, using the reflective qualities of your walls to heighten the live stereo effect. Your entire living room becomes a giant sound chamber. No matter where your Quadrant speakers are, you can go anywhere in the room and be surrounded by rich, full-range stereo sound! This freedom of placement is particularly important if you're planning ahead toward 4-channel stereo with its four separate speaker systems.

Hear for yourself the dramatic difference between Scott Quadrant stereo and conventional speaker stereo. Your Scott dealer will show you that no matter where you place your speakers, or what shape your room, the Quadrant will deliver hole-free wall-to-wall stereo. $149.95 each.



Two woofers are mounted on opposite sides of the speaker enclosure, each radiating low frequency sound of more than 180°.



Four midrange/tweeters are mounted one to a side, each projecting high frequency sound waves in an arc of more than 90°.

H SCOTT®

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Export: Scott International, Maynard, Mass. 01754

*Patent applied for.

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TANDBERG

NEW 6000X STEREO DECK

A Dynamic New Thrust In Recording Capability Featuring Our Unique CROSSFIELD Design

The 6000X challenges the most precise professional instruments that sell for $1,100 or more. At 3¾ ips, this new stereo deck surpasses the 7½ ips performance of our world famous, *top rated Model 64!* It offers the truest high fidelity you've ever heard, even at 3¾ ips (40-18,000Hz ±2½ db). And, it incorporates a completely new design for the 70's...fresh, interesting —inviting use!

Convince yourself. Would you believe...
- Signal-to-noise ratio at 62db
- 70db dynamic range, plus
- An additional 24db overload protection
- Peak reading instruments

And would you believe...
- 4 hyperbolic, mumetal screened, precision-gapped heads
- Mixing, cueing, source vs. tape monitor, sound-on-sound, add-a-track, remote control
- Independent mike/line recording controls and stereo mixing

Although we hesitate to say that this is the world's best tape recorder, we have yet to find its equal! Try the new 6000X. Record any material at 3¾. Play it back. Compare with others at 7½. You'll see that *you now* can make professional quality recordings. Your franchised dealer has it now ... **$499.00**

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AUDIO

February 1970 Vol. 54, No. 2

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FEATURE ARTICLES

EQUIPMENT PROFILES

RECORD/TAPE REVIEWS

AUDIO IN GENERAL

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Walter Carlos, creator of "Switched-On Bach" and "The Well-Tempered Synthesizer," uses the Dolby System.

Mr. Carlos says, "The raw materials of electronic music — the outputs of my Synthesizer, for example — are sounds which can be varied from striking purity to extreme complexity. After a desired sound is created, often with considerable effort, it must be preserved with care, to be combined later with others in a meticulous layer by layer process. The noises of magnetic recording are significant hazards in this regard, since they are particularly noticeable in electronic music. However, my experience confirms that the Dolby System effectively attenuates the noise build-up in electronic music synthesis. My studio at TEMPI is equipped with ten Dolby units, which I consider to be indespensible in my work."

Whatever your recording activities, the dependable Dolby System can help you make good recordings even better. Now in use in over 100 companies in 21 countries around the world.

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One of our competitors just introduced a two-stage synchronous motor.

We're bloody flattered.

In 1967, Garrard engineers perfected the Synchro-Lab motor. A revolutionary two-stage synchronous motor.

Revolutionary because, for the first time in a component turntable, it successfully combined two types of motor: induction and synchronous.

The induction portion supplies the torque to reach playing speed instantly. The synchronous section then "locks-in" to the 60-cycle frequency of the current.

This produces unvarying speed, and thus unvarying pitch, despite variations in voltage.

A missed point

Not surprisingly, a competitor has introduced a copy of our Synchro-Lab motor on their costliest model.

Alan Say, our Chief Engineer, comments. "We're bloody flattered. After all, being imitated is a rather good indication of how significant an innovation really is.

"But, curiously, they seem to have missed the point.

"With a non-synchronous motor, you need a heavy turntable. Its momentum makes up for fluctuations in motor speed.

"Our purpose was to achieve constant speeds, using a lighter turntable and the least possible power. Less power and a low mass table help reduce rumble. And relieve mechanical stresses all 'round.

"When we went to the Synchro-Lab motor, we cut our turntable weight to three pounds. They're still using a seven pound disc.

"So, while others *are* following our lead, there's no comparison yet.

"Quite selfishly, we're pleased on both counts."

H. V.'s commitment

This is, by no means, the first time a Garrard innovation has been imitated.

Spurred by a commitment of some thirty years standing, Garrard engineers have recorded every major advance in automatic turntables.

H. V. Slade, a co-founder and Garrard of England's uncompromising Managing Director from 1918-61, set policy which endures to this day.

"We will sell a Garrard in the U.S. *only* when it is more advanced than any machine available there."

Satisfyingly dissatisfied

"To fulfill such an unbending commitment," points out Alan Say, "requires chaps who are perpetually dissatisfied." The 1970 Garrards would seem to bear that out.

Last year, we added viscous damped tone arm descent for gentler, safer cueing.

But offering an automatic turntable that was undamped in automatic cycle ran cross-grain of logic. So one of our engineers devised a linkage system between the changing mechanism and the damping "jack".

Now Garrard's tone arm is damped in automatic.

This year, a popular and exclusive Garrard feature—our disappearing record platform—has become a non-disappearing record platform.

Someone at our Swindon labs discovered we could make it a bit larger and stronger that way. A small advantage, and a difficult decision. But one that would have pleased H. V.

And we've added a counterweight adjustment screw to our gimbal-suspended tone arm. It permits you to balance the arm to within a hundredth of a gram.

To quote our Mr. Say, "Anyone with a touch sensitive enough to take full advantage of it should be cracking safes with the Lavender Hill Mob."

An embarrassment of riches

You can select from not one, but six Garrard component models. Prices range from the SL95B (left) at $129.50 to the 40B at $44.50.

Although prices vary from model to model, Garrard standards do not. Only the number of refinements possible at each price.

It can be a most difficult choice. Your dealer can help you make it.

Garrard

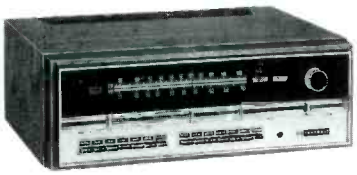
What's New In Audio

Dual 1219 Base and Dust Cover. Model, DC-9X

A very practical solution of what to do with those extra spindles and cartridges is offered by this new base from Dual. The entire dust cover can be raised and left in a tilted position, or removed entirely when desired. It is made of heavy, smoke-tinted plexiglass and costs $24.95.

Check No. 8 on Readers Service Card

New Heath 100 Watt AM-FM Receiver Kit



This receiver, model AR-29 is said to be the result of a two year project to produce the best available medium power stereo receiver. It has many of the features of the larger AR-15 and uses no less than 65 transistors, 42 diodes, plus four IC's containing another 56 transistors and 24 diodes. A computer designed 9-pole LC filter provides ideally shaped bandpass selectivity of 70dB and eliminates IF alignment, and new plug-in circuit boards further simplify assembly. Other features include a massive, regulated power supply, built-in test points, linear motion lever controls, and level controls on all inputs. IM distortion is quoted as less than 0.25% at any power level. Kit price $285.

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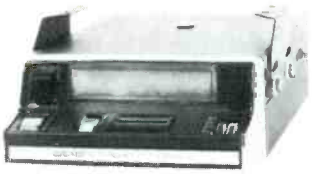


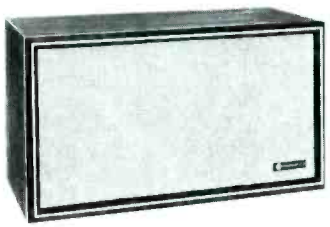
8-Track Stereo Mobile Cartridge Player

Craig model 3122 is an 8 track unit with FM radio and it incorporates an electro-magnetic latch which is claimed to give longer life to tape cartridges. The cartridge is held in playing position and when power is removed from the electro-magnet the latch disengages the cartridge from contact with the drive capstan. Other features of the Craig 3122 are "disappearing" dial markings, stereo indicator lights, AFC and automatic cartridge and track selection. It can be powered by any 12 volt (negative ground) system and the dimensions are 6 by 3 inches high by 9½ inches deep. $119.95.

Check No. 18 on Readers Service Card

New 3-Way Bookshelf Speaker System

Lafayette have introduced a new version of the Criterion 100A called the 100B. It uses a 10 inch woofer with 5½ lb. magnet and 2 inch voice coil and 3½ inch midrange and a 1½ inch super tweeter. The enclosure is a tube vented reflex type and the response is given as 30 to 19,000-Hz. A level control for high frequencies is fitted and power handling capacity is 40 watts. Dimensions 21½ by 11¾ by 9½ inches, finished on 4 sides in oiled walnut. $44.95.



Check No. 16 on Readers Service Card

Pioneer SX-1500TD Receiver

This new receiver from Pioneer uses four IC's in the I.F. section as well as a monolithic IC incorporating 30 transistors and 10 diodes in the multiplex circuit. Other features include two tuning meters, two separate pairs of phono inputs, center channel output sockets, and a microphone mixing facility. The panel is finished in silver and black contrasting with the polished rosewood endpieces. $399.95.

Check No. 10 on Readers Service Card

Do-It-Yourself Organs

Just opened in California is a new plant specializing in organ parts, kits, consoles and accessories. It also has a showroom and the enterprise is run by Robert Eby, well known founder of the Artisan line of organ kits. The photograph shows Robert Eby holding a transistor tone generator which replaces no less than 12 organ pipes!

Check No. 14 on Readers Service Card

Shure Microphone

A new unidirectional microphone which combines numerous professional features with a low cost has been introduced by Shure Brothers Inc. It is called the Unisphere model 588 and its features include a true cardioid pickup pattern, built-in wind filter and a chrome-plated all-metal case. Frequency response is quoted as 80 to 13,000Hz and it is available in high, medium and low impedances. $60 complete with adapter, switch and 2 feet of cable.

Check No. 12 on Readers Service Card

Hitachi Receivers

Hitachi announce the release of three new receivers, the SR-300, SR-400 and SR-500 with ratings of 12,25 and 40 watts per channel respectively. All models feature automatic stereo switching, interstation muting, switched loudness control and center tuning meter. Sensitivity of the SR-600 illustrated is claimed to be 1.7μV for 20dB quieting.

Check No. 6 on Readers Service Card

Catalogues

From Electro-Voice, two catalogues covering the complete range of high fidelity products including speakers, speaker systems and stereo components. Full of easy to read tips on hi-fi.

Interested in headphones? Sharpe Audio has a new free catalogue describing their range of headsets which include induction and wireless (RF) types plus audio station and sound centres ancilliary equipment.

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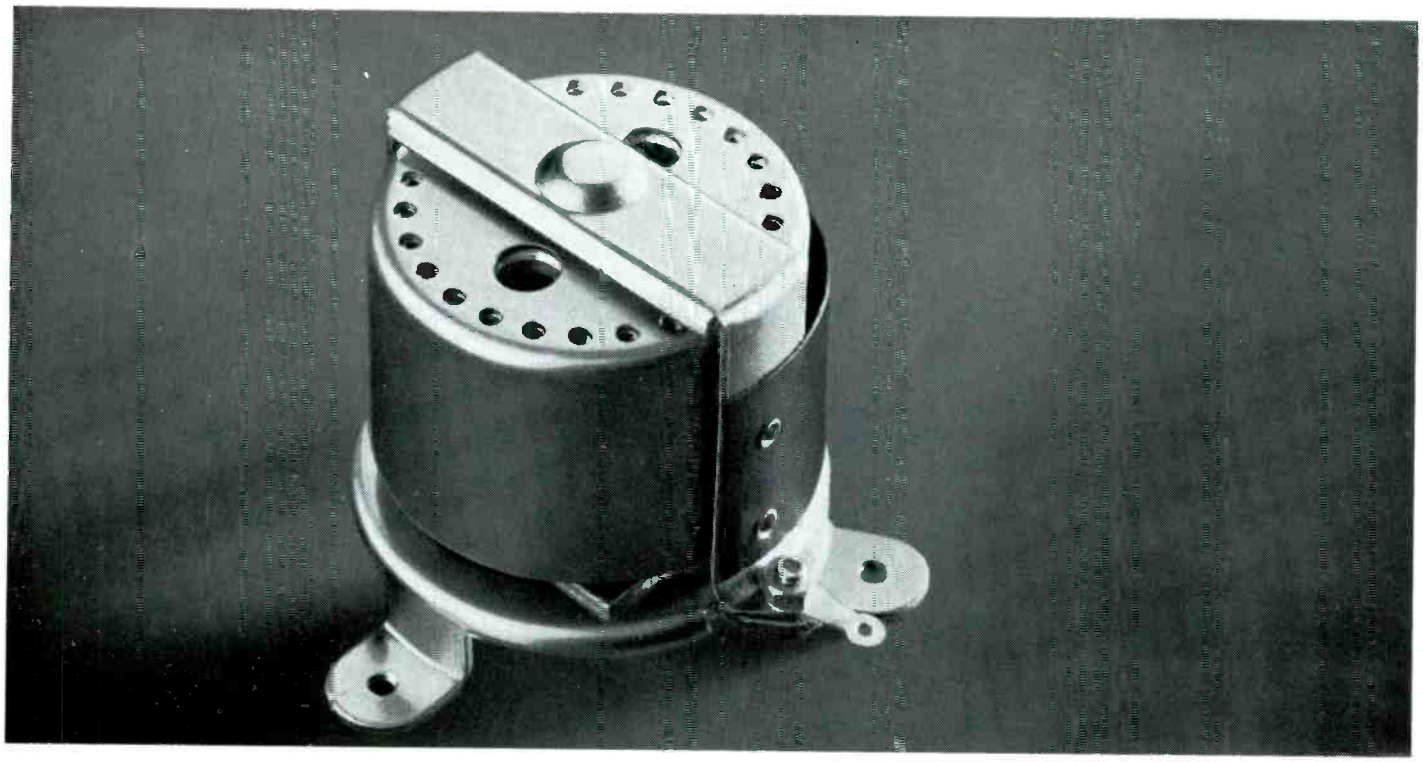
Check No. 7 on Reader Service Card →



The Outer Rotor Motor:

Attains new heights in turntable efficiency

JVC announces the outer rotor motor—destined to revolutionize the record player as we know it.

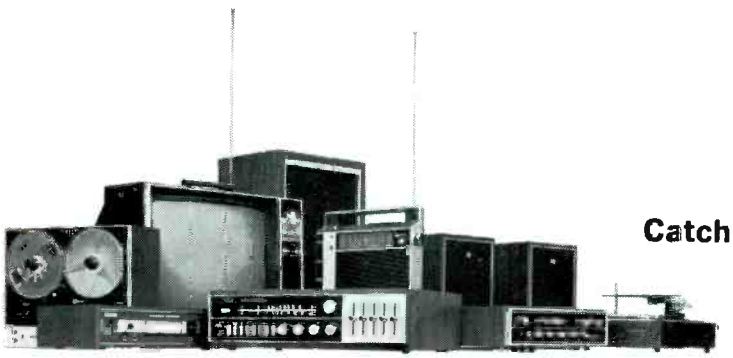
Bigger and substantially heavier than the old inside rotor type, the outer rotor motor achieves new heights in efficiency while cutting power consumption in half. Among its advantages are greatly improved balances for a significant reduction in vibration and more even rotation, and completely eliminated hum, thanks to the much reduced leakage flux.

The outer rotor motor is a feature of both the JVC 6102 and the 5201. The 6102, a beautifully-styled 4-speed component, offers the option of records or 8-track stereo tapes and sells for just $139.95.* The 5201, another 4-speed model, is a bargain $94.95.*

JVC's 5204, with 2-pole synchronous motor, is priced at just $59.95.*

If greatly improved turntable efficiency makes sense to you, drop in and see your nearest JVC dealer. Only he is offering it.

*Suggested list prices



Catching On Fast

JVC

JVC America, Inc., 50-35, 56th Road, Maspeth, New York, N.Y. 11378 A Subsidiary of Victor Company of Japan, Limited, Tokyo, Japan

Coming in March

SPECIAL LOUDSPEAKER ISSUE . . .

Directory of Loudspeaker systems

Q's and A's on Loudspeakers—What the specifications mean, how to choose a loudspeaker, white noise testing etc.

Loudspeakers Past and Present—by Roy Allison and Bob Berkovitz

Bass Response and Enclosure Size—Victor Brociner looks at some design criteria

How to add a Bass Speaker to an Electrostatic Unit—Nate Garfinkel describes how he added a 'super woofer' to his Quads.

PLUS:
Record and Tape Reviews and all the Regular Features

ABOUT THE COVER: This very elegant installation was designed by David Beatty Hi-Fi for Mr. and Mrs. Rogers of Kansas City. Equipment used includes McIntosh amplifiers and tuner, Dual 1009 turntable and Bozak 302A's speakers which are housed in the lower section of the pier cabinets.

Audioclinic

JOSEPH GIOVANELLI

If you have a problem or question on audio, write to Mr. Joseph Giovanelli at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped, self-addressed envelope.

More Selective TV Sets

Q. My color TV *set is being fed by a rotating, high-gain, highly directional antenna, 66 feet above the ground.*

Distant stations are often adversely affected by adjacent-channel interference caused by strong local stations. Why are not TV *set makers able to eliminate this adjacent-channel interference?*

Great strides have been made in this respect where the FM band is concerned. Crystal filters, such as are used in Heath and other tuners, allow one to listen to a weak station even when it is next to a strong local one. It is possible to apply similar circuits to a TV *tuner so as to accomplish similar results for the video and audio performances of* TV *sets? If so, why are not the manufacturers making use of these filters?*—Chester J. Alkema, Grand Rapids, Mich.

A. There is no technical reason why television receivers cannot be made more selective, and, at the same time, produce pictures with even more definition than is presently the case.

However, economic considerations play a role here. Because competition among manufacturers is keen and costs are measured in tenths of a cent, a manufacturer would have to be pretty sure that these circuit changes would really be important to the consumer before he would decide to include them.

As it is, you are one of the very few who is interested in having such a set. Hence, you will either have to do some design work of your own or simply enjoy your present set.

Another problem regarding selectivity is one which involves the front end. Very often, amateur radio operators are blamed for creating interference to television receivers. True, the emanations of some of these transmitters do find their way into television sets, but it is not the fault of the operator of the station. It is the fault of poor front-end design of the television receiver which allows this type of interference to enter the receiver. This is the kind of problem that most television users would not understand as a design problem, and, therefore, would not complain to the manufacturers of the sets.

Q. I want to learn how to construct a voltage divider to put between my cartridge and preamplifier in order to cut down first-stage overload.—R. B. Taylor, Sellersville, Pa.

A. You can make a voltage divider which will reduce the output from your cartridge sufficiently to prevent overloading of the early stages of your equipment.

There are two resistors needed. Their total ohmic value, when they are connected in series, is 47 k ohms so that it will match the cartridge's requirements. You probably will need to reduce the signal output to perhaps

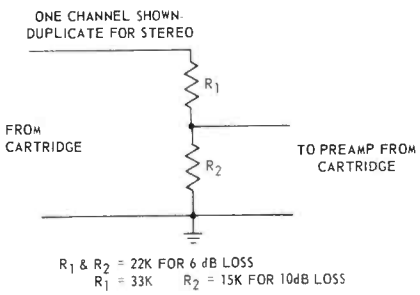


Fig. 1

6 dB below its present level. Therefore the value of each resistor should be 23.5 k ohms. However, there is no such value made in standard resistance sizes. Therefore, 22 k ohms is the closest obtainable value. (There will be no degradation of sound quality as a result of this slight discrepancy.) See Fig. 1.

If the signal level is still too high, change the resistances to 33 k and

COLUMBIA STEREO TAPE CLUB now offers you

ANY 5 7" REEL-TO-REEL STEREO TAPES

FOR ONLY $1.00 EACH plus mailing and handling

if you join now, and agree to buy five additional tapes during the coming year, from the hundreds to be offered

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180166

180323

172411

181636

171504

180349

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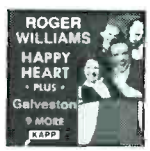

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143024

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FREE—if you join now

REVOLUTIONARY SELF-THREADING TAKE-UP REEL

Just drop the end of the tape over this reel, start your recorder, and watch it thread itself! Unique Scotch® process automatically threads up tape of any thickness, releases freely on rewind.

JUST LOOK AT THE FABULOUS SELECTION of best-sellers the Columbia Stereo Tape Club is now offering new members! The greatest stars... the biggest hits... and all available in the incomparable stereo fidelity of 4-track reel-to-reel tape! To introduce you to the Club, you may select any 5 of the stereo tapes shown here, and we'll send them to you for only one dollar each! That's right... 5 STEREO TAPES for only $5.00, and all you need to do is agree to purchase as few as five more tapes during the coming year.

AS A MEMBER you will receive, every four weeks, a copy of the Club's entertaining and informative music magazine. Each issue describes the regular selections for each musical interest... hits from every field of music, from scores of different labels.

If you do not want a tape in any month—just tell us so by returning the selection card by the date specified... or you may use the card to order any of the other tapes offered. If you want only the regular selection for your musical interest, you need do nothing—it will be shipped to you automatically. And from time to time, the Club will offer some special tapes which you may reject by returning the special dated form provided... or accept by doing nothing.

YOUR OWN CHARGE ACCOUNT! Upon enrollment, we will open a charge account in your name. You pay for your tapes only after you've received them. They will be mailed and billed to you at the regular Club price of $7.98 (occasional Original Cast recordings somewhat higher), plus a mailing and handling charge.

FANTASTIC BONUS PLAN! Once you've completed your enrollment agreement, for every tape you purchase you will be entitled to an additional stereo tape of your choice for only $2.00... or you may choose one FREE tape for every two tapes you buy.

SEND NO MONEY NOW! Just fill in and mail the coupon today!

Note: All tapes offered by the Club must be played back on 4-track reel-to-reel stereo equipment.

APO, FPO addressees: write for special offer

COLUMBIA STEREO TAPE CLUB
Terre Haute, Indiana 47808

SEND NO MONEY—JUST MAIL COUPON

COLUMBIA STEREO TAPE CLUB, Terre Haute, Indiana 47808

Please enroll me as a member of the Club. I've indicated below the 5 tapes I wish to receive for only $1.00 each, plus postage and handling. Include the self-threading takeup reel FREE.

SEND ME THESE 5 TAPES (fill in numbers)

My main musical interest is (check one):

☐ **CLASSICAL** ☐ **POPULAR**

I agree to purchase five selections during the coming year, under the terms outlined in this advertisement... and I may cancel membership at any time thereafter. If I continue, for every tape I purchase I will get an additional stereo tape of my choice for only $2.00 . . . or I may choose a FREE tape for every two tapes I buy.

Name .....
(Please Print) First Name Initial Last Name

Address .....

City .....

State ..... **Zip** .....

461—6/T1

15 k ohms. The 15 k resistor should be placed closest to ground because it is the one which must develop the lower voltage.

Place the two voltage dividers (one for each channel) in a metal container. Mount the input and output connectors to the box. This arrangement is useful in eliminating unshielded resistors and their leads.

It might be convenient to have a method whereby any voltage between zero and the full output capability of your cartridge can be fed to the input of your preamplifier. This can be accomplished through the use of a 50-k ohm potentiometer. See Fig. 2. The 50-k ohm resistance value of this pot is close enough to the recommended 47-k ohm cartridge termination that there will be no degradation of sound quality.

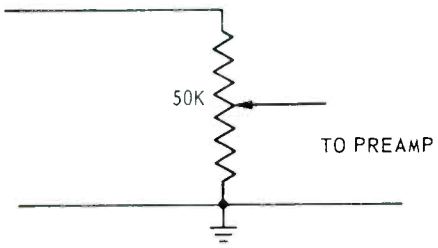

Fig. 2

As with the circuit of Fig. 1, this potentiometer should be mounted in a metal box.

If you have a VTVM and a test record, the two potentiometers needed for stereo should be adjusted to provide equal voltages between their wipers and ground.

Regardless of which of the two circuits you choose, connect a ground wire between the metal box in which the circuit is mounted and your preamplifier.

Background Music

Q. What is meant by "background music"?—Mr. M. Reich, Bronx, N.Y.

A. Background is that music which you often hear in restaurants, banks and other establishments. It is carried on ordinary FM stations, probably the very ones to which you listen all the time. You cannot hear it at home, however, because it is transmitted on what is known as a subcarrier. The main FM carrier is modulated by the audio you hear, plus some stereo information which you cannot hear on a monophonic receiver. Furthermore, there is a 67-kHz carrier which also frequency modulates the main carrier. This carrier, in turn, is frequency modulated, and contains the background music service.

In order to receive this background music programming, the FM signal is first detected in the usual way. The regular program is then filtered out of the resulting audio and all that is left is the recovered 67-kHz subcarrier This carrier is then passed into circuitry which detects its FM just as is done when detecting the FM with which you are familiar.

Transformers in Solid-State Amplifiers

Q. It appears that most, if not all, of the latest solid-state amplifiers have no output transformers, driver, or interstage transformers.

Do you feel there is any advantage in performance of either having driver transformers or not having them? Would their presence deteriorate transient responses?—Leonard Drasin, Jamaica, N.Y.

A. I do not think driver transformers impede good transient response. They are not required to handle much power. Further, because of the low impedances associated with solid-state circuitry, these transformers will not have sufficient turns to cause severe losses of highs because of distributed capacitance.

The use of driver transformers solves some design problems, especially that of phase splitting.

Meter Disagreement

Q. Several FM stereo tuners I have seen have both a center-of-channel tuning meter and a signal-strength meter. If properly aligned, should the two meters agree with one another as to the point of best tuning? If not, which one should be relied on?—Leonard Drasin, Jamaica, N. Y.

A. Theoretically, center channel meters both should give proper readings at the same time. In other words, when the center-of-channel meter shows proper tuning, this reading should coincide with the maximum signal point on the signal strength meter. I noticed, however, that in many cases the readings will correspond at one particular signal strength —that used when aligning the tuner. A signal which is stronger or weaker than this one will produce disagreement between the meter readings.

I am not altogether sure of the reason why this discrepancy should exist. My personal guess would be that it has something to do with current flowing in the detector circuit and the changes in diode conductivity with varying signal levels feeding this circuit.

In any case, when the two meters disagree, rely on the center-of-channel meter reading.

Of course, if the readings are in violent disagreement, it might indicate that you must have your tuner aligned.

Relay Protection for Solid-State Amps

Q. Why don't manufacturers use relays as aids in protecting solid-state circuits from overload?—Name withheld.

A. When transistor circuits are overloaded, they often burn out with lightning speed. Therefore, in order to protect such devices, the protective circuit must sense the potential danger even faster than it can act to cause the damage.

Being mechanical devices, relays are not fast acting. Therein lies the basic reason why they are not used in solid-state amplifier protective circuits. Further, relays are not completely reliable in other ways. Oxidation of their contacts can make them useless. Failure of a restoring spring can also destroy their usefulness.

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The Very Best

Some people can accept reduced quality in their audio components. For others — the recording engineer, the professional musician, the music connoisseur — there is only *one* quality — *the very best.* These are the uncompromising — the people who choose CROWN.

They know that behind each Crown product stands the teamwork of some of the nation's finest audio engineers and proudest American craftsmen. These are the designers whose innovations have led the tape industry with exclusive electro-magnetic braking, the first solid-state components, original computer logic tape control, the new industry standard power amplifier — DC300, and now an ultra-flexible, high-performance control center. These are the craftsmen who carefully hand-fabricate and test each unit, entering measurements on individual proof-of-performance records. This is the product line that is worthy the pride of both its makers and its owner.

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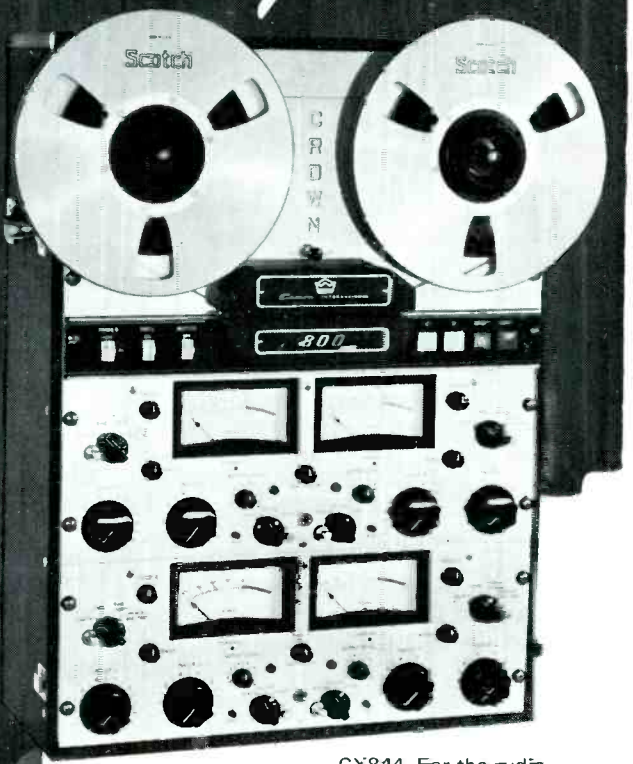
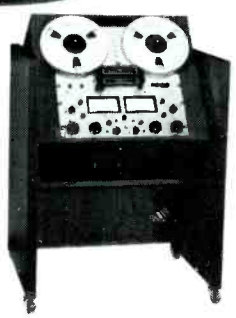


CX844 For the audio perfectionist or professional, the ultimate in live recording. 4 channels in-line, 3 speeds, computer logic tape control never breaks tapes, remote control optional, sound-on-sound, sound-with-sound, echo effects

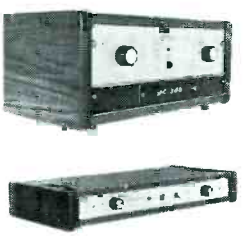
All models shown feature total silicon solid state design, non-mechanical brakes, precision micro-gap heads, 5" VU meters, 4 mic or line inputs, 3/16" panel with massive central casting, third head monitor with AB switch, rugged construction, 100 hours in-plant testing.



CX722 Superlative professional quality with outstanding flexibility for on-location recording. 2 channels, 3 speeds, pushbutton electric control, remote start/stop optional, sound-on-sound, sound-with-sound, echo effects, shown in studio console.

SX724 Professional performance at a minimum price. essential for the finest component systems. 1/4-track stereo 2 speeds, push-button electric control, remote start/stop optional, sound-on-sound, shown in scuff-proof carrying case.

SX824 For the serious audiophile, the ultimate home recorder. 2 channels, 2 speeds, computer logic control never breaks tapes, remote control optional, sound-on-sound, shown in genuine walnut hardwood cabinet.



DC300 Laboratory standard basic amplifier. 300 watts per channel RMS, complete output protection, extreme purity, shown in walnut cabinet

D40 The ideal monitor amplifier. 40 watts per channel RMS, compact, low distortion, shown in walnut cabinet.

BEHIND THE SCENES

BERT WHYTE

My involvement with four-channel stereo gives me a distinct feeling of *deja vu* . . . as well it might, since there are so many parallels between four- and two-channel stereo. But there are differences, there are dissimilarities between the two, which pose some formidable problems.

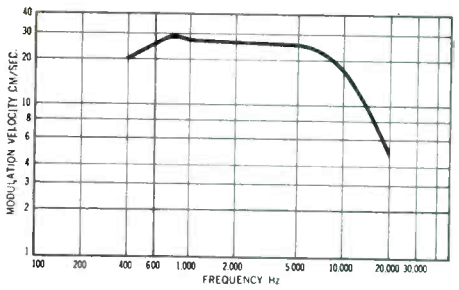
As was the case with two-channel stereo, there is a great deal of experimentation to be done in the matter of microphone placement before we can optimize this parameter of four-channel sound. Of course, it goes without saying that microphone placement before we can optimize variables . . . hall acoustics, individual engineering and recording-director preferences, the special demands of certain repertoire . . . that it is unlikely there will be a set inflexible standard. But we must at least have a guideline which intelligently used will provide some reasonable standard of rear-channel information. It is also highly probable that those engineers who make the most successful four-channel recordings will have modified their recording techniques even in respect to their handling of the front channels. They will have embraced new recording disciplines in which they think of the totality of the four-channel medium, rather than the front and rear channels as separate entities. This was one of the problems in the early days of two-channel stereo . . . many engineers accustomed to monophonic recording couldn't orient themselves to stereo . . . they found it hard to "think stereo." In fact you would be amazed by the number of the engineers in those days who thought stereo was "stuff and nonsense!"

Experimentation with mike placement naturally means live recording . . . and here is where the problems begin. One might safely assume that a typical professional classical recording session would be the best place for four-channel experiment, and for the most part this is correct. However, everyone on the session is always aware of the giant taxi meter ticking inexorably . . . the staggering cost-per-minute union rate of the musicians . . . and if things aren't going smoothly, the four-channel experiments would have to be abandoned. It is still a two-channel market and that comes first. The alternative of course, is a situation where one can experiment without the terrible pressures of a commercial session. This involves many factors and unfortunately it is going to be a more complicated procedure than it was in the early days of two-channel stereo. For example, there is the matter of the two rear microphones. In 1951 when I was recording stereo with Maestro Stokowski, the recordings were of actual concerts. Whenever possible I hung my microphones, but often had to use mike stands and booms. This did not too greatly discommode the audience . . . the mikes blocked very little in the way of sight-lines and the cables snaked along the foot of the stage to one of the wings where I was ensconced with my recording equipment. Monitoring was strictly via earphones. As you can imagine, if you tried to do the same thing today for a four-channel recording of a concert, unless you could hang the rear mikes you would be out of luck as the hall management almost certainly would not permit the placement of mike stands and booms among the audience at an appropriate place in the hall. Over-riding all this would be the matter of union clearance to make the recording. Since what we were doing was strictly experimental and non-commercial, Maestro Stokowski was able to arrange clearance with the local involved. What would happen today is a matter of considerable conjecture.

Well, no matter. If we are to learn anything about this new medium we all must experiment. I have the big Crown four-channel recorder and ancillary equipment and I'm rarin' to go! So where do we conduct our experiments? If you are fortunate enough to be near a large city or live in one, the blessed musical amateurs are the answer. In New York, the suburbs are quite well endowed with amateur symphony orchestras . . . community orchestras with as many as 80 members. There are choral groups galore . . . the colleges and universities have many musical organizations of various types and sizes. In the city itself, there is almost an embarrassment of musical riches in the large churches. As I write this in early December, the churches are offering Bach Cantatas, the Bach "Christmas Oratorio," the "Messiah," Mendelssohn's "Elijah," the Poulenc and Vivaldi Glorias, Kodaly's "Te Deum," numerous organ recitals and much more. Some of these productions are quite modest with little more than piano or organ accompaniment. Others have brass ensembles or chamber orchestras. Still others have elaborate presentations with full orchestra and some well-known soloists. Okay, so these groups don't exactly sound like the Philharmonic and the Westminster Choir! Some of them are surprisingly polished performers and when all is said and done, they are more than adequate for the experiments. Getting permission to record these various groups ranges from dead easy (especially if the director of the group is a hi-fi nut) to in some cases impossible, due to the presence of some union musicians within a particular group. It is a very hide-bound attitude because for one thing the group is not good enough to compete commercially with the great orchestras and choruses. For another thing, the union musicians ultimately will benefit from four-channel sound when it eventually supplants two-channel stereo, since all of the symphonic literature including all the old pot-boilers, will have to be newly recorded for the four-channel medium. My experiences in recording two-channel stereo with organizations of this kind has been generally good with amicable relations and polite co-operation.

Once you have decided what groups you would like to record, there is a preliminary task to take care of before asking permission to record. You must visit the hall or church where the groups are to perform and check the acoustics. Churches are rarely "dry" acoustically, but many halls are quite "dry" with reverb periods so short that they would be useless for four-channel recording. Or there may be other acoustical problems like severe slapback, too long a reverb period, multiple echos, bass attenuation, and so on. No use trying to record four-channel stereo in a poor acoustic situation. Assuming a good recording locale has been found it is now necessary to face the fact that you probably won't get permission to place your rear mikes among the audience at the actual concert. Even if you could, the location you choose probably wouldn't be right and you could hardly change the mike positions during the concert. After all, the idea is to experiment, right? Thus we must accept the idea that the best time for our experiments is during rehearsals. Then we can make all the changes we desire. I personally plan to attend two rehearsals . . . the one before the final and the final rehearsal. In this way I may find a mike placement that seems to have possibilities, and then if I am lucky, I may get permission to hang the mikes in that position and thus record the actual concert. If this is not possible, the final rehearsal will still furnish sufficient data. Since four-channel tape can be spliced as easily as two-channel, a skillful editor may be able to put together a complete performance.

Second to one...



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If it were not for the incomparable Shure V-15 Type II (IMPROVED) Super-Track, the Shure M91E Hi-Track would be equal or superior to any other phono cartridge in trackability . . . regardless of price! The astounding thing is that it costs from $15.00 to $50.00 less than its lesser counterparts. And, it features an exclusive "Easy-Mount" design in the bargain. Trade up to the M91E now, and to the V-15 Type II (IMPROVED) when your ship comes in. Elliptical Stylus. ¾ to 1½ grams tracking. $49.95. Other models with spherical styli, up to 3 grams tracking, as low as $39.95.

SHURE

M91E HI-TRACK PHONO CARTRIDGE

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We're making progress, but alas, this business of four-channel recording is quite cumbersome. For example, let us assume we are in a good hall at a rehearsal. Your front mikes are in place and the rear mikes some distance down the hall. Ideally, to monitor the four-channel sound you will be in a room off to the side of the hall, or perhaps behind the stage. To reach this room from the hall you may need as much as a hundred feet of mike cable for each mike. You can't monitor in the hall with loudspeakers, hence the long cables. In the room you will have your four-channel recorder, two stereo amplifiers, two loudspeakers in front of you, and two in back of you. The room will have been heavily damped with rolls of builder's fiberglass insulation . . . we want to hear the acoustics of the hall with a minimum of interference from the room acoustics. Unless you are rich enough to have an intercom system or closed-circuit TV, you'll be working blind in the room. What comes over the mikes will have to be your cues to start recording. In the case of a concert, you'll practically have to run continuously. To cope with varying acoustics of halls our mike complement would include four with cardioid pattern and four omnidirectional, to be used in various groupings. A mike that would greatly facilitate experiments is the AKG Model C-12 which has a number of patterns remotely switchable from the recorder locale. As you can see, the recording and monitoring of four-channel stereo darn near requires an expedition with pack mules! As an admittedly lazy type, the thought of all that equipment appalls me. How much easier two-channel stereo recording is! You can usually have your recorder right in the hall or church with you, albeit off to one side, your mike runs are short and oh! those lovely earphones! Surely the inventive genius of the audio industry can devise some way to monitor four-channel stereo via earphones? Perhaps two separate elements in each earphone reproducing front and rear mikes? The front sound would undoubtedly swamp the rear. How about one pair of phones on the ears and the other signals via bone conduction? You can't blame me for trying! Probably the simplest thing is to plug phones alternately between front and rear amplifiers and try to hazard a guess as to whether you have too much or too little rear information. It's worth a try although I don't really believe it will work. There are many other facets of four-channel recording that require special attention, and as knowledge is acquired we'll pass it on to you.

* * *

Because we writers for the various high fidelity publications are always in the van on new developments, such as four-channel stereo, there is sometimes a tendency to forget that it takes time for these advances to reach the hi-fi public. A case in point is four-channel sound. It has occupied a great deal of space in the press, and as a very significant step forward in the quest for sonic realism, this is as it should be. However, the cold facts are that only a miniscule fraction of the hi-fi public have even seen four-channel stereo equipment, let alone heard a demonstration of this new sound. The market today is two-channel stereo and is likely to remain so for a considerable time. The two-channel stereo medium has reached a point of high refinement with some truly sophisticated recording and playback equipment. The past several years have seen the emergence of new formats of two-channel stereo, notably the eight-track cartridge and the cassette. In the broadest terms, the cartridge has been considered a playback medium and the cassette a recording medium. At the present time the cartridge is the champ in the pre-recorded tape market, with the cassette coming up fast. The advocates of the cassette are quick to point out that it has now developed a solid market for pre-recorded tape and at the same time retaining its recording ability, and they see in this the eventual demise of the cartridge. Only time will tell if they are right, but there have been some developments in eight-track cartridge recorders which may cause the cassette people to revise their timetables. The cartridge recorders have generally been maligned because of the difficulties inherent in the endless loop format. Their critics point out the lack of fast forward and rewind, the inability to spot specific selections on the tape, their alignment problems with the very narrow tracks, and so on. While the cartridge will probably never equal the cassette for ease of recording, there now are eight-track machines with fast forward and a magnetic coding system exists, (though not yet in use) which is said to make spot selection on the tape feasible. As to cartridge recorders, a few of the early models suffered from a variety of ills . . . poor motion, bad cross-talk, poor timing facilities. The attraction that a good workable cartridge recorder would have for many people is undeniable. Even at discount prices the average cartridge is over four dollars and the motorist who has car stereo has an insatiable appetite for new material. With blank cartridges costing quite a bit less than the recorded variety, they could "roll their own" cartridges with any kind of music they want from FM tuner, phono, or open-rell tapes. Furthermore, they could erase the material when they tired of it and record something new, and really cut the cost.

To be frank, I had about given up any hope that I would ever see a cartridge recorder that really worked, when I spotted a new unit at the Consumer Electronics Show made by the Telex people in Minneapolis. Designated the 811-R, it had all the amenities needed for recording cartridges, with a few new twists to ease the task. The Telex people were kind enough to send me one recently, and to put it succinctly, it works and works well. I refer you to our PROFILE on the unit in the October, 1969, issue for all the nitty-gritties about frequency response, wow and flutter, distortion, and so on. To my ear, all parameters were "go" . . .

(Continued on page 79)

"NO! I DO NOT WISH TO HEAR YOUR NEW LP RECORD."

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$169.95 Kit
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We have always tried to give outstanding value at Dynaco; and when we work on new designs, our primary objectives are quality and value—quality second to none, and prices far below the levels of competitive quality. Following this philosophy, we have designed our newest power amplifier, the transistorized Stereo 80, in the tradition of the famous Dynaco Stereo 70—extreme reliability, conservative operation and specifications, outstanding quality, and moderate price. The Stereo 80 is compact (it fits any remote space, but is handsome enough to keep on display), cool-running, simple, and elegant. It delivers 40 watts **continuous** power per channel, with both channels operating simultaneously, from 20 Hz to 20 kHz.

The Stereo 80 and our PAT-4 preamplifier create an outstanding combination which delivers crystal clear sound, free of noise and distortion, and with excellent flexibility as the control center for the most complete hi fi installation.

Further, we have combined these units into a single, transistorized integrated package, the SCA-80, and through careful design have achieved SYNERGISM*, the combination giving even greater value than the sum of its parts. The SCA-80 has all the qualities of the Stereo 80 plus the performance and many of the features of the PAT-4—center-out tone controls, low noise, multiple input facilities, headphone output, center-speaker output without the need for a separate amplifier, and so on. It provides complete control facility and yet it is simple to operate with a basic two-knob control action for those who do not require sophisticated features such as loudness, filters, blending, and other subtle variations.

The SCA-80 gives quality plus compact flexibility. The Stereo 80 plus the PAT-4 gives quality, increased flexibility for installation, and greater range of control function. The Stereo 120 plus the PAT-4 gives all this plus extra power plus the benefits of a stabilized highly filtered power supply which makes performance independent of power line variations. In all these choices, quality and value are outstanding—and in the SCA-80, the synergistic benefit enhances the value of the unit.

*SYNERGISM—"Cooperative action of discrete agencies such that the total effect is greater than the sum of the two effects taken independently . . ."

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Tape Guide

HERMAN BURSTEIN

If you have a problem or question on tape recording write to Mr. Herman Burstein at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. Please enclose a stamped, self-addressed envelope. All letters are answered.

Q. I am striving for a high-quality system of music reproduction via phono records. I have been told that the thing to do is record the first play of a high-quality disc with a professional-type tape recorder and with the finest disc-playback equipment. In doing this I will have the same fine sound as the record and will not have the loud tape hiss characteristic of many prerecorded tapes. Is this information correct? If so, must I stick to 1½-mil tape to minimize print-through? Or would I have better sound if I just spent the money for a good turntable, arm, and cartridge, and replaced the disc every 25 plays or so? —David E. Sosin, New Haven, Conn.

A. The information given you how to get a hiss-free recording is correct. I think that if you went to 1-mil tape you would be unlikely to find print-through a significant problem unless you employed excessive recording levels. If your purpose in acquiring a tape machine is only to copy phono discs, you might be better off by not buying the tape machine and instead putting your money—probably a lesser sum—into a first-rate record player, arm, and cartridge. Using a top-flight cartridge that permits tracking at 1½ grams or less, you are unlikely to scratch the record, esecially if you use a cueing device.

Reports have it that when a disc is played with good equipment, it can last with little loss of quality for 100 plays, 200 plays, and perhaps more. If you have anything of a record collection, the chances of playing the same record more than 200 times or so seem small.

It is only fair to add that owing to technological improvements, pre-recorded tapes are getting better in various respects, including hiss. Hence you may want to review the entire situation in terms of the pre-recorded tapes *now* available.

Q. I have developed the following problem with my tape recorder. During a stereo recording my machine will record properly on the right channel, but only very slightly on the left. So when I play back the tape it will only play the right channel. But if I play a pre-recorded tape, both channels reproduce 100%. I have tried adjusting the bias control to supply more bias to the tape head, but this does not help. I have also tried trouble shooting with a VTVM and comparing the voltages for the right channel (good) and the left channel (poor), but I am still unable to solve the problem. The tape head is a combination one, having all three functions (erase, record, and playback) in one head. I am wondering if this might be the problem.— James David Gorr, Philadelphia, Pa.

A. Your tape machine combines a record-playback head and an erase head in one casing. Inasmuch as your machine functions correctly in playback, this appears to eliminate the head as the source of trouble. The difficulty, then, seems to lie in the electronics. Apparently the bias oscillator circuit is o.k. inasmuch as you are recording satisfactorily on the right channel. Perhaps not enough bias current is reaching the left channel. Your machine has separate bias-adjust controls for the left and right channels. Did you adjust the correct one? If insufficient bias is not the trouble, then some electronic fault in the left channel, involving such elements as resistors and capacitors, would be responsible. Expert troubleshooting should reveal the culprit.

Q. For the past year and a half it has been necessary for me to store all my pre-recorded tapes while I was away. Before I left, I packed them on edge in their boxes, firmly but not tightly in corrugated cartons, and placed the cartons in a closet where the temperature and humidity would not be expected to vary a great deal. Last month I returned, only to find that a number of my tapes now suffer from rather pronounced edge warp or fluting at regular intervals during the first couple of hundred feet. Although this physical distortion does not appreciably affect the music quality, it is disturbing to me, and I am anxious to correct the condition if possible and to avoid similar problems in the future.

Almost all of the damaged tapes are ° ° ° tapes, most of them full-reel twin-packs. The culprit therefore seems to be either the brand's tape or reels. I suspect the reels, since they are solid plastic except for one long notch, and the tape nearest the notch seems to be the most badly fluted. I hesitate to blame my tape machine for faults in winding tension, etc., since I have a very good unit which I have serviced and adjusted regularly. Is there anything I can do to correct the tapes already damaged and to prevent similar damage in the future?—Roger C. Anderman, Dayton, Ohio

A. One step is to avoid in the future your mistakes of the past. This means using those brands of tapes and those types of reels which have given you least trouble, and making sure to rewind or replay your tapes every few months. I have never been able to get a mis-shapen tape back into condition. Some claim to have obtained an improvement by winding and rewinding the tape several times. I guess their degree of success depended on how badly warped or fluted the tape was.

Are you perhaps storing your tapes after rewinding them at high speed? Tapes are best stored after having been wound at normal operating speed (such as 7.5 ips) rather than after high speed winding. Also (including from the point of view of minimizing print-through) it is desirable to store tapes tail-out, namely with the last part of the recording at the outside of the reel; and then rewind the tape just before playing it.

It may be of some point to mention that using good tape and good reels, I have stored some recorded tapes flat rather than on edge, in extremes of temperature (well over 100° and below freezing) and humidity (close to 100); and that they have shown little if any signs of physical deterioration after several years under such conditions. Æ

A-1500U • Exclusive triple-motored drive system • 4 precision heads for instant off-the-tape monitoring • Mike-line mixing • 4 independent amplifiers • Automatic tape lifter • All-pushbutton controls, automatic shutoff • Stereo echo for special sound effects • Choice of cabinet or portable styling

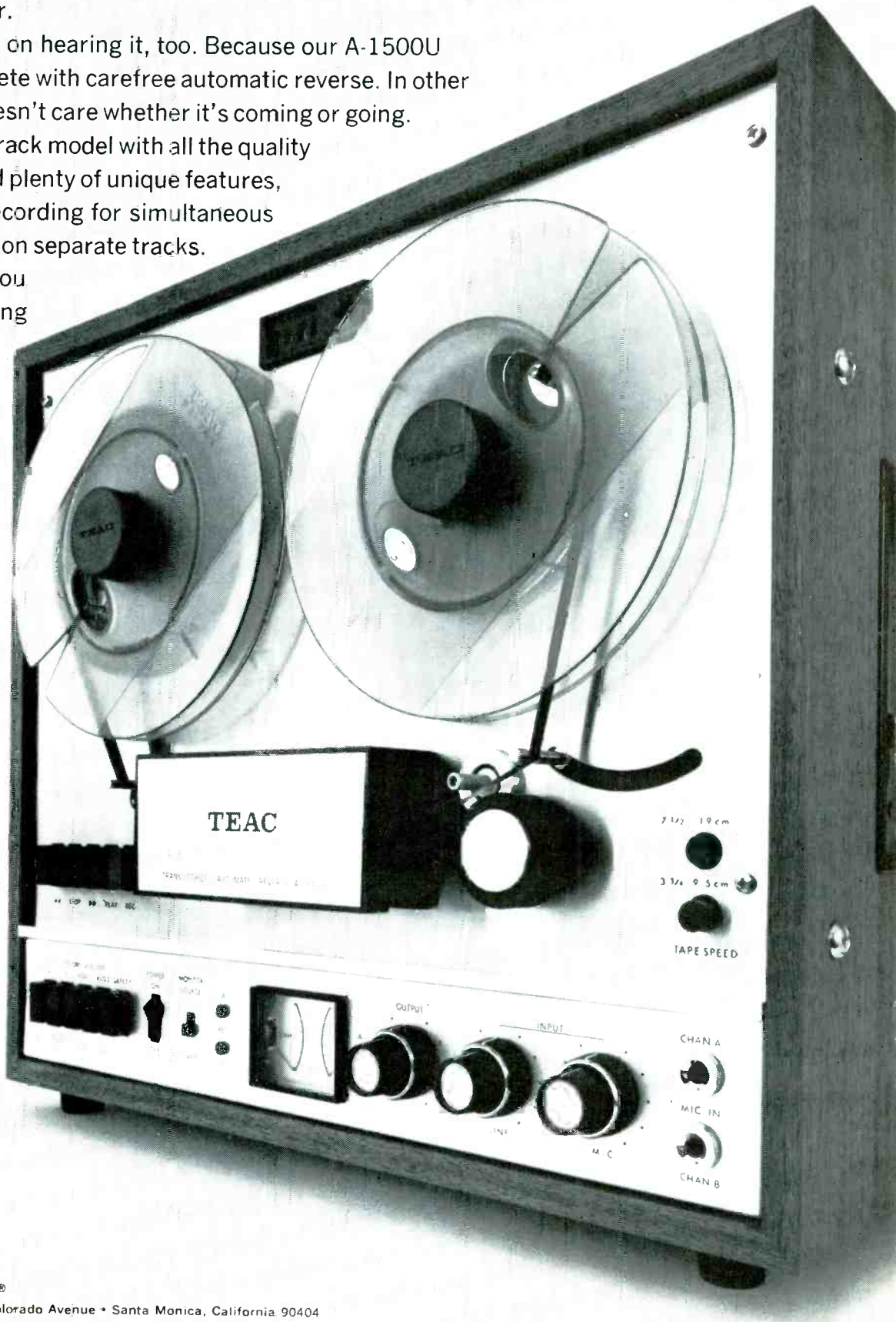
Play it by ear.

You'll like what you hear.

And you can go right on hearing it, too. Because our A-1500U tape deck comes complete with carefree automatic reverse. In other words, this machine doesn't care whether it's coming or going.

It's a standard four-track model with all the quality TEAC is famous for. And plenty of unique features, like the popular ADD recording for simultaneous playback and recording on separate tracks.

Yes, you'll like what you hear on this one. Including the price. (That part sounds almost as good as your favorite tapes.)



TEAC

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EDITOR'S REVIEW

New Editor

Masthead readers will already have noticed that a new editor is at the Helm of AUDIO after nearly three years under the guidance of Arthur Salsberg, who has left for—we hope, for his sake—bigger and better fields. At least, he is not in competition with AUDIO.

George W. Tillett assumes the reins of the magazine, effective with this issue, and it seems only fitting that he should be introduced by the publisher in his first issue. Mr. Tillett has an excellent technical background, having been most recently executive vice president of Audio Dynamics Corporation, and formerly director of engineering at the Milroy, Pennsylvania, plant of Fisher Radio Corp. Before coming to the United States in 1966, he was technical director of Wharfdale, chief engineer of the British Heath company, chief engineer Decca Radio Company, and so on. He is a member of the AES, and follows the usual hobbies of the audio enthusiast—photography, music, and literature.

We trust AUDIO's readers will welcome Mr. Tillett to his new responsibility.

C. G. McProud, *Publisher*

* * *

I have always considered "Audio" to be the finest magazine in the world in its class and so it goes without saying that I am very proud to be associated with it. Will there be any changes? Yes, and No. All the regular features will be retained and if possible expanded, but I do want to devote more space to beginners–and also include more articles of musical interest. I would like to remind readers that we are always interested in publishing articles dealing with some aspect of Sound Reproduction—or music. Manuscripts should be typed or clearly handwritten and submitted with drawings where necessary. To avoid disappointment, it is suggested that would-be authors send in a rough precis first.

4-Channel

Although some experts hail 4-channel stereo as representing as big an advance on 2-channel as 2-channel was on mono, some people are not yet convinced. In his article on page 12, Bert Whyte mentions thhe skepticism of some engineers, saying it reminded him of the early days of stereo—the original 2-channel variety. Such a comparison may be a little unfair but I certainly remember how difficult it was to sell the idea of stereo to the unbelievers. In those days (not so long ago, really) it was part of my duties to visit major companies and advise them on 2-channel amplifier and equipment design, as we were releasing stereo discs in a few months time. I found more than half of the people I saw—engineers and executives alike—were dubious about the whole thing. Some thought stereo was nothing but a gimmick thought up by money-grabbing record companies, others stubbornly refused to believe in its practicality! I well remember a senior executive of a large corporation saying with some heat "Stereo? ridiculous—like being in a ships' cabin listening to music coming from two portholes!" Needless to say, he would rather not be reminded of this comment today. . . . Of course, disbelieving cynics are not just confined to Hi-Fi circles: the Xerox idea was turned down by company after company for years as being non-commercial, and how about television? Going back to the days when a handfull of enthusiasts were watching tiny 1 inch or 2 inch pictures on home made equipment (how many remember those spinning disc viewers?) a very famous expert said "Television will never be more than a scientific curiosity, a toy."

Prediction

At least two companies are experimenting with multiplex disc recording for 4-channel stereo and one firm is reputed to be well on the way towards perfecting a wide-band disc recording system suitable for video. I would say in about 2 years time, teenagers will be able to *see* their favorite groups on their record players as well as hearing them.

Sound And Fury

"Audio" medal of the month should go to a Mr. Irwin A. Bazelon who wrote to "The New York Times" as follows: . . . "I for one am sick to death of the wisdom of 15 year-olds and the musical genius of 20 year-old electric-guitar players. Never before in history have so many said so little with such overpowering amplification. Our musical culture has witnessed the great contemporary marriage—the American Money Rhythm and the electric-guitar." *G.W.T.*

Only Pickering offers Dynamic Coupling Factor... your assurance of greater listening pleasure

A sophisticate who can afford the finest in stereo components and equipment, would select the Pickering XV-15 Cartridge labeled 750E, 400E or 350. They're the proper ones to deliver "100% Music Power."

With the more simple equipment that characterizes today's informal living, the XV-15 with a DCF of 150 or 200 will assure "100% Music Power."

A Pickering XV-15 Cartridge with a DCF of 100 or 140 will guarantee "100% Music Power" on the type of set up that the young in your house use for dancing or listening.

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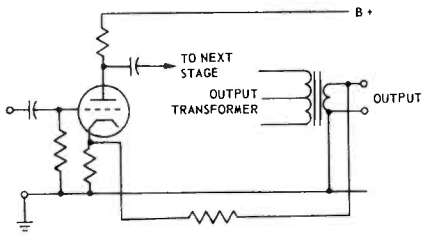

Fig. 1-1—A simple type of tube amplifier circuit feedback, to illustrate a question over which some confusion arises. Do we consider first-stage gain with or without degeneration due to the cathode resistor?

LET'S START our feedback circuitry study with a fairly familiar type of tube circuit (Fig. 1-1). Here a signal from the output is fed back to the cathode of an earlier, usually the input, stage. The feedback seems easy enough to calculate, at first sight, until you start trying to do the actual figuring. First you want to know the forward gain, which you could either calculate or measure.

Now you find that the first stage presents a problem. Do you figure the gain with the cathode resistor bypassed or un-bypassed? The first inclination is to say un-bypassed, because it actually has no bypass. We've noted that some circuits of this kind use a bypassed cathode resistor as well as an un-bypassed one of much lower value for the feedback (Fig. 1-2). Maybe it is done that way to avoid this problem.

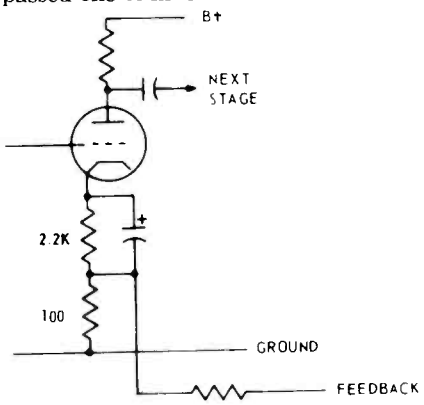

Fig. 1-2—An input stage used in some designs that avoid the question posed by Fig. 1-1.

To all intents and purposes, the smaller-value resistor is not big enough to produce appreciable degeneration in the first stage itself, and the bypassed cathode resistor provides bias without degeneration. Thus the calculations are easier or, at least, they bypass the problem.

But avoiding a question doesn't always answer it. Sometimes using a much-smaller-value resistor to isolate the two effects will not provide a workable answer.

In the simpler circuit (Fig. 1-1), do we figure the gain with the cathode bypassed or un-bypassed? Suppose this first stage uses a tube with an amplification factor of 100 (at the chosen operating point) a plate resistance of 80K and a plate load of 100K (d.c.) with 390K in the following-stage grid, a.c. coupled to it (Fig. 1-3). This makes the a.c. load for the plate 80K, and the gain, working with the cathode bypassed, would be 50.

Now assume the cathode resistor, to give correct bias, needs to be 2.2K. While 50 times the grid-to-cathode signal appears at the plate, 50 x 2.2/80 = 1.375 times grid-to-cathode signal appears cathode-to-ground. Un-bypassed, the single-stage AB factor is 1.375, or the (1 + AB) factor is 2.375, which represents a feedback of 7.5 dB. The working gain, un-bypassed, will be 50 divided by 2.375, or 21.

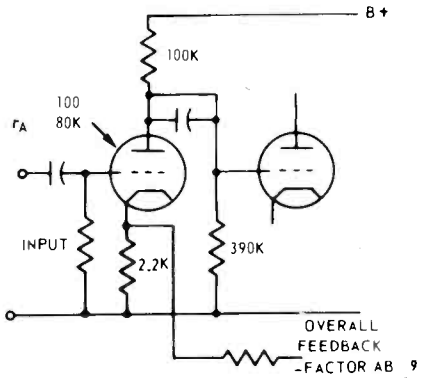

Fig. 1-3—The input stage of Fig. 1-1, with some details put in, for the sake of calculating an example.

Rather than working the gain all through the amplifier, we'll skip that and assume that we find, or design it so that, the feedback signal from the output, as measured across the same cathode resistor of 2.2K, is 9 times the grid-to-cathode input signal. In saying it that way, we are ignoring the feedback due to this stage, as we have just calculated it.

The key question now facing us is, how much feedback will we have? The total AB factor, due to both feedbacks, is 1.375 + 9 = 10.375. Knowing this, we can figure the effect of removing the feedback in two ways (Fig. 1-4). If we disconnected the feedback resistor from the cathode (A), the feedback-factor operative changes from 11.375 (1 + 10.375) to 2.375, to give a gain change of 11.375 divided by 2.375, or 4.8, which is 13.6 dB.

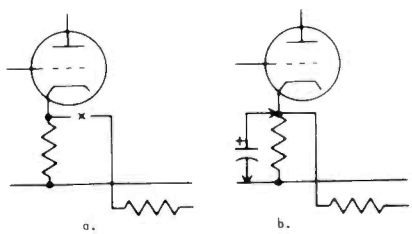

Fig. 1-4—Two ways of "removing" the feedback: (A) by disconnecting the feedback resistor at the cathode; (B) by bypassing the feedback voltage at the cathode.

But if we bypass the cathode resistor (2.2K) with a capacitor of large enough value to eliminate all feedback signal, the gain change will be 11.375, or 21.1 dB. So our question is, which is the effective amount of feedback, 13.6 dB or 21.1 dB?

Of course, each of these answers is correct, for the particular way of measuring it: if you open the feedback resistor connection, the gain will go up by 13.6 dB and if you bypass the cathode resistor, the gain will go up by 21.1 dB. But this doesn't answer the question. Suppose the output stage has 4.3 per cent distortion at maximum output: how much will this distortion be reduced by the feedback? By a factor of 4.8 or of 11.375?

The thing to recognize here is that the input being amplified is the difference between the original (external) input and the feedback signal. The 4.3 per cent distortion of this difference signal (grid-to-cathode of the input stage) will be included only in the AB factor for the overall feedback calculated as 9, yielding a feedback factor, *for this purpose,* of $(1 + AB) = 10$. So the distortion due to the output stage will be cut from 4.3 per cent to 0.43 per cent. We're making progress.

For distortion reduction, we have 20 dB of feedback, although different ways of measuring the feedback will yield results of 13.6 or 21.1 dB, neither of which is applicable. If you measure the change in distortion, or the change in output impedance due to this feedback, your results will confirm the calculated 20-dB feedback factor.

A Tricky Tube Circuit

Before we leave tube circuits to go into transistors, there is another interesting combination feedback problem. It is found in either the unity-coupled or the twin-coupled output circuits. We show the unity-coupled version, output stage only, in Fig. 1-5.

In this circuit, the output stage operates each tube as a pentode, using the double-wound primary of the output transformer to provide pentode conditions for each tube. Both primaries have identical turns, in fact, they're usually bifilar wound.

The plates and screens have the same d.c. operating voltage. But the a.c. (signal) voltages, as cathode and screen of each tube swing in the same direction by an equal voltage, are such that the screen-cathode voltage of each tube does not change during the signal cycle. This is pentode operation.

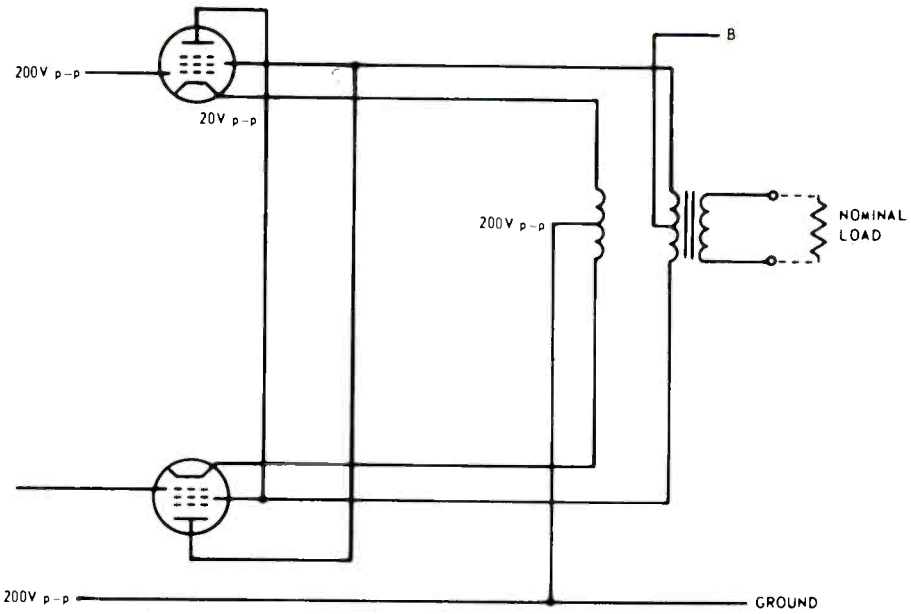

Fig. 1-5—The unity-coupled output circuit that forms the second subject for investigation in this article. Voltages indicated are developed later in the text, with the nominal load connected.

The plate and cathode-cum-screen of each tube swing in opposing polarity with equal voltages (a.c.). As the grid voltage will be referenced to ground, the cathode-cum-screen half of the total output voltage is feedback to the grid circuit. In referring to half the output voltage, we are taking the tube's viewpoint, not that of the output transformer. As the latter has separate primaries, these may be regarded equally well as series or parallel elements of total output.

Assume that, with normal output load, a grid-to-cathode signal of 20 volts peak produces 200 volts peak each at plate and at cathode/screen. For the output stage, the AB factor is 10, so the feedback factor is 11, reducing output stage distortion, regarded as a push-pull pentode stage, by this factor.

So far, no problem. But now comes the question of providing the drive voltage for the grids, which needs to be 220 volts peak for each output grid. As we shall see, this modifies the figuring we have just done.

Using a pair of ordinary triodes we run into design problems (Fig. 1-6). If we use a plate resistor of high enough

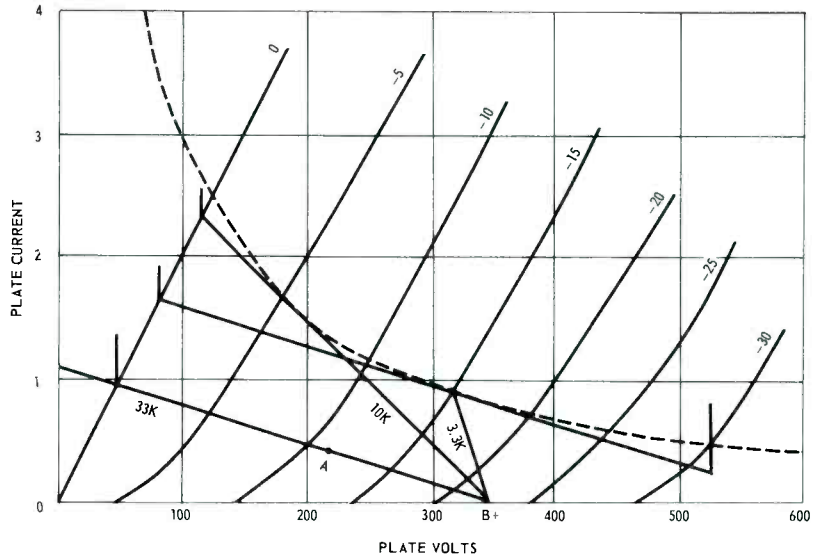

Fig. 1-6—Load lines applied to triode characteristics to illustrate the problem of obtaining the large swing to drive the output tubes in the unity-coupled circuit. Three are shown, using 33K and 10K as simple plate resistors (operating points being indicated by a dot on the line) and a 3K resistor with bootstrap to make its effective resistance (to a.c.) equivalent to 33K, allowing almost twice the swing to be obtained.

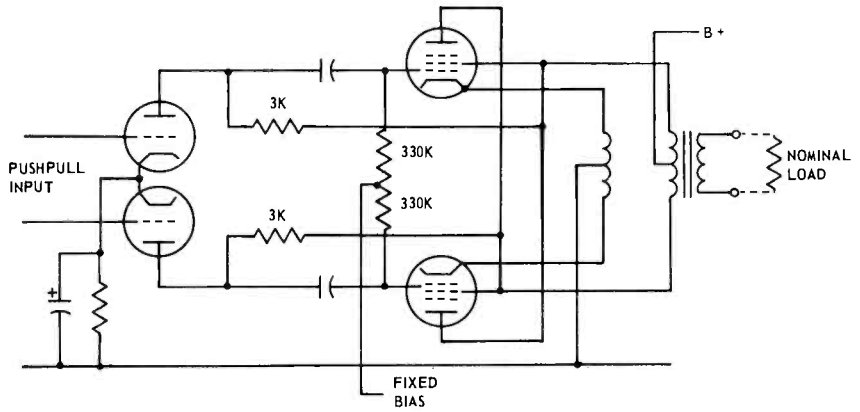

Fig. 1-7—The complete bootstrap circuit that provides the longer load line of Fig. 1-6 for each tube.

value to produce adequate swing, the operating point drops in voltage. If we use a lower value of plate resistor, we lose swing and run into excessive dissipation, in both resistor and tube.

This problem can be neatly overcome by the so-called boot-strap circuit (Fig. 1-7). Here the swing available at the screen of the output stage is used to boost the swing at the plate of the drive stage, using a plate resistor of much lower actual value. The actual resistor of 3K drops only about 30 volts at the plates. The voltage at its "top" end swings 200 volts while the plate swings 220 volts.

From the drive-stage tube's viewpoint, the plate resistor "looks like" 33K (Fig. 1-8). This makes the getting of 220 volts peak to drive the output stage grids a simple matter, and at the same time avoids the need for excessive dissipation. Really, it's positive feedback. But now comes the question: what effect does this positive feedback have on distortion, impedance, and so on?

We have already seen that the feedback multiplies the effective plate load for the drive stage by a factor of 11. Does this mean it also provides further reduction of distortion and output source impedance by the same factor?

To answer this, we have to see how the drive swing at the grids of the output stage is affected, relative to the signal input to the drive stage. Assume the drive stage uses triodes with an amplification factor of 20 and a plate resistance of 7.7K. With an effective plate resistor of 33K and following-stage grid resistors of 330K, making an a.c. load for the drive-stage plates of 30K, the stage gain is 20 x 30/7.7 = 16.

But we have no feedback across this stage, unless overall feedback is applied from output to input later, which we haven't considered yet. However, the behavior of this stage can reflect into the output stage source impedance and distortion reduction.

First assume the output stage is somehow driven from a pure voltage source and that the pentode source impedance is 10 times its load impedance. Actually, this value will fluctuate during the signal cycle, but we'll use this as an average.

The combined output impedance, as it would be measured from plate to cathode, is 10/11 of nominal load, when nominal load is connected, without feedback (that is, if the output is rearranged as a regular pentode push-pull, with neither cathodes nor screens swinging).

Now we put in the feedback product of AB = 10, still with nominal load connected. The feedback factor is 11, so the combined impedance is 10/11 divided by 11, or 10/121 of nominal load, measured plate to cathode. Make this a decimal, or 0.0827. Now this includes the nominal load as a parallel element, so the effective source impedance, under this condition is

$$0.827(1 - 0.0827) = 0.0904$$

This represents a damping factor very close to 11.

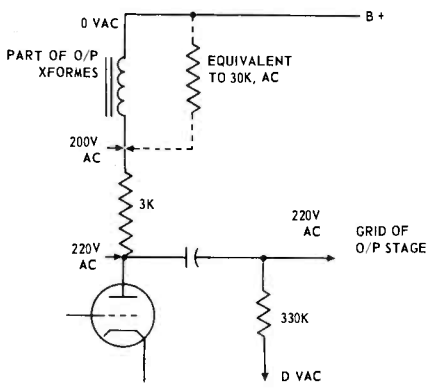

Fig. 1-8—How the bootstrap makes the 3K resistor look like a total of 33K.

Now consider how the drive stage affects this. The best way to do this is to ignore output stage non-linearity and assume that the value of source resistance of 10 times the load impedance is linear. This won't be true, but using is for calculation purposes will enable us to predict smaller changes that don't materially affect linearity.

Still using the 200 + 200 volts peak output, with no load, the grid-to-cathode input to the output stage will only need to be 1/11th of the 20 volts needed when the load is there, or 1.82 volts. Instead of requiring 220 volts peak at the grids, the output stage now needs 201.82 volts peak.

But the factor by which the effective plate resistor of the drive stage is multiplied is changed, from 11 to 121. The effective resistance rises from 33K to 363K. The a.c. load (with the 330K grid resistor coupled in parallel) rises from 30K to 173K. This raises drive-stage gain from 16 to 19.1. To give 200 + 200 output with load connected, the drive stage needs a grid input of 220 divided by 16, or 13.75 volts peak. To give 200 + 200 output without the load connected, the drive stage needs 201.82 divided by 19.1, or 10.5 volts peak.

Viewed the other way, if the amplifier is operated below its clipping level (in both conditions) with constant input to the drive-stage grid, the output voltage will rise in the ratio 10.5:13.75 when load is removed. So the effective source resistance is the nominal load multiplied by 3.25/10.5.

$$(3.25 = 13.75 - 10.5)$$

So with the bootstrap drive, the source resistance is 0.31 times the nominal load, or the damping factor is 3.2, as compared with the earlier figure, not taking the drive stage into account, of 11.

And what of distortion? This is a difficult question. For one thing there are several sources of distortion now: drive stage as well as output stage, not to mention possible distortion due to the output transformer and the interaction between the output stage and its transformer (causing the cathode and screen not to be perfectly in-phase, for example).

So we must make some assumptions. Let's assume the output transformer

(Continued on page 75)

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THE TRANSIENT POWER OF A X-TEREO SYSTEM

O. S. GODA

This paper*will present theoretical and practical aspects of simulating a concert orchestra in a home by means of state-of-the-art audio components. Emphasis will be placed on the transient characteristics of music, quality of components, room acoustics, and especially transient power capabilities of amplifiers and speakers. Transient power is very important because the dynamic range of a room background noise to the stimulated full concert orchestra may be from 60 to 70 decibels. The home audio system should be capable of handling this dynamic range. The Xtereo system uses three speakers driven separately by solid-state power amplifiers.

Transient responses of musical instruments can be represented by Fourier transform:

$$f(x)=\frac{A_0}{2}+\sum_{n=1}^{\infty} A_n \cos nx+\sum_{n=1}^{\infty} B_n \sin nx \qquad (1)$$

First and second terms of Eq. *(1)* represent even harmonics while the third term represents odd harmonics. When $n=1$, the wave form consists only of the fundamental. It is known that n must equal up to nine in order to describe a transient pulse truly. Any transient waveform can be reduced to sinusodial waveforms by knowing its amplitude, harmonic relation, and phase.

If the highest fundamental of a musical instrument were 4 kHz, and up to the 7th harmonic were required to reproduce the instrument, we immediately require a bandwidth of 28 kHz. Some present manufacturers still claim that 20 kHz is adequate for musical reproduction. This may be partially true if one were to take only the frequency into account. However, phase relations must be considered. A 0.5- and 1-dB change in the edge response constitute respectively 20- and 27-deg. phase shifts. After about 8 kHz, this phase shift for the higher harmonics can change the original waveform unless the bandwidth of the whole stereo system is beyond 50 kHz. An ear cannot respond to 50 kHz or 150 kHz. However, an ear can detect what is happening to the particular sound up to medium frequency (20 kHz) due to frequency limitation or, more seriously, phase distortion.

If one accepts the fact that a wide-bandwidth system is needed, this can be easily related to transient rise time of any linear amplifier.

$$t_r=0.35/freq.\ at\ -3\ dB \qquad (2)$$

This is the reason why modern solid-state amplifiers with extremely wide frequency bandwidth can realistically reproduce transient waveforms. According to measurements conducted by Luce and Clark[1], the transient-attack time of the highest musical note is approximately 1 millisecond where the transient-attack time is defined as that period from the beginning of the signal to the point at which the magnitude is 3 dB down (0.707) of the magnitude).

If the average listening level for a classical music were 0.25 acoustic watts, and the peak output of a full concert orchestra can develop[2] up to 17 dB above this average or equivalent to 50 times, then 12.5 watts acoustic power will be developed. A concert orchestra is semi stereo. If one were to attempt to reproduce this orchestra, a wall of speakers will be required. This is impractical. Therefore, a good compromise which excels the present stereo system is the three-speaker system.[3,4] The advantage of the three-speaker system over the two-speaker system is beyond the scope of this paper. In general, it can definitely be stated that full stereo is unrealistic and restricts the listener's position; and the three-speaker system improves this situation. Tappan's paper states that for proper acoustical balance from a three-speaker stereo (Xtereo) system, the center speaker should have at least 6 dB less power. An 8-dB differential has been selected or 0.159 the power of the left or right speaker in this system by 440-Hz and 1000-Hz audio signals and various musical program materials. This means that most of the power must be developed from the left and right speakers $(1-0.159)\times 156$ watts $=131$ watts.

Table I. Sound Pressure Level and Electrical Power for Speaker Efficiency

SPL db	W	Electrical Power P_e				
	Acoustical Watts	Efficiency 10%	8%	5%	1%	0.5%
113	13.04	130.4 watts	163	261	1304	2608
110	6.54	65.4	81.8	130.9	654	1308
105	2.06	20.6	25.8	41.2	206	512
100	0.655	6.55	8.2	13.1	65.5	131
95	0.216	2.16	2.7	4.32	21.6	43.2
90	0.134	1.34	1.68	2.68	13.4	26.8

The Journal of the Acoustical Society of America has studied and measured the acoustical power outputs of various orchestral instruments. In this study, the maximum absolute output as well as the frequency range in which they occurred were determined.[5] The power output of a piano was between 0.42 to 0.69 acoustic watts, with the greatest power being distri-

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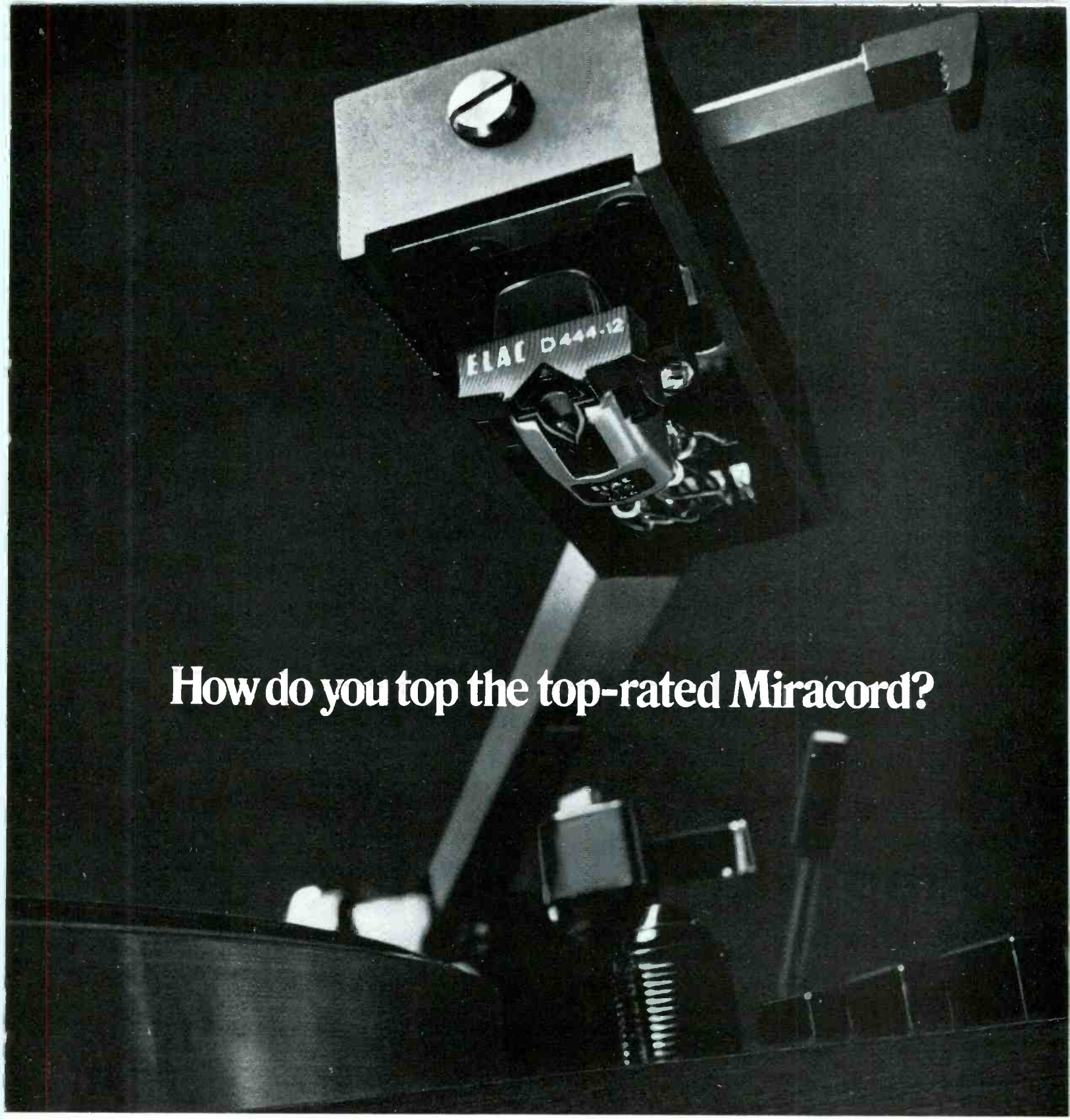
*Presented at the Stereophonic Club of Southern California meeting of 18 November 1967 in Orange, Calif.



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(Continued from page 26)

buted in the 250- to 400-Hz range.

Acoustical terminology will be defined and related to an actual system. The sound pressure level is 20 times the logarithm of the ratio of the measured effective sound pressure to the reference sound pressure. The reference sound pressure $P_{ref} = 0.002$ microbar.

$$SPL = 20 \log (p/p_{ref}) dB \qquad (3)$$

The acoustic power level of a sound source is 10 times the logarithm of the ratio of the acoustic power radiated to the reference acoustic power.

$$PWL = 10 \log (W/W_{ref}) = 10 \log W + 130 \, dB \qquad (4)$$

Where W = acoustic power in watts
W_{ref} = reference acoustic power of 10^{-13} watts

The exact method[6] is beyond the scope of this paper. However, a simplified expression of Eq. *(3)* which includes the sound absorption coefficient of a room is

$$SPL = PWL + 10 \log \left[\frac{1}{S_w} + \frac{4}{R} \right] + 0.5 \, dB \qquad (5)$$

Where PWL = Eq.*(4)*
S_w = area of radiating wall in ft²
R = $aS/(1-a)$
S = total area of all surface of the room in ft²
a = average absorption coefficient of the room

The second term of Eq. *(5)* has a negative sign because S_w and R are much greater than unity. From reference 6, the average absorption coefficients are:

Dead room	$a = 0.40$
Medium dead room	$a = 0.25$
Average room	$a = 0.15$
Medium live room	$a = 0.10$
Live room	$a = 0.05$

The average absorption coefficient can be calculated by

$$a = \frac{a_1S_1 + a_2S_2 + a_3S_3 + \cdots a_nS_n}{S}$$
$$S = S_1 + S_2 + S_3 + \cdots S_n \qquad (6)$$

Where S_1, S_2, *and* S_n are the areas of particul- absorbing surfaces in ft²; and a_1, a_2, and a_n are the absorption coefficient associated respectively with

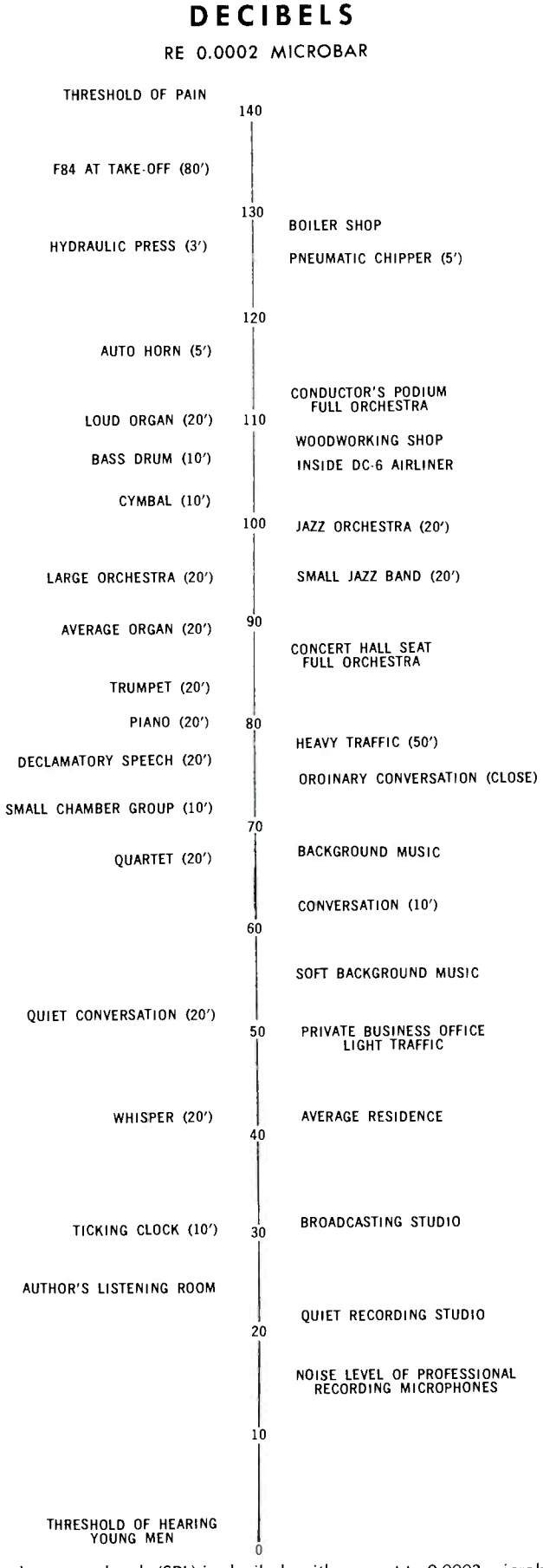

Fig. 1—Sound pressure levels (SPL) in decibels with respect to 0.0002 microbars.

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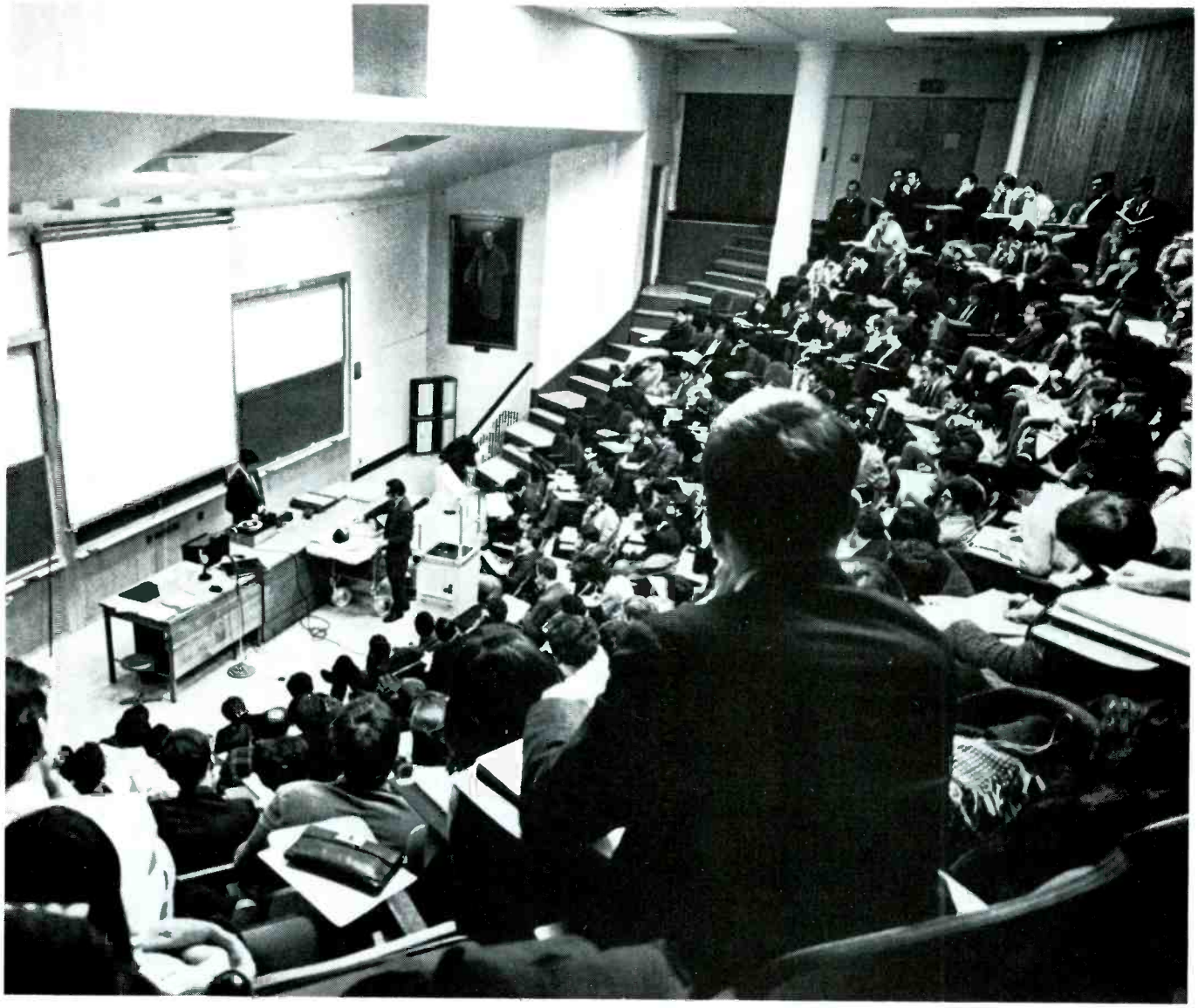

One of the world's leading medical schools has recently solved a long-standing problem in its training of first-year students: how to enable a lecturer and hundreds of listeners to hear simultaneously the heart sounds of a living patient. Usable microphonic pickups exist; the difficulty arises because most of the sound in a heartbeat is in the range below 40 Hz. At these very low frequencies, even many speaker systems which seem to have "good bass" are unable to provide results comparable to those of a doctor's stethoscope. The stethoscope, simple as it is, couples the physician's ears directly to the patient's chest, and can, in principle, convey acoustic pulses near 0 Hz. It is this kind of extended low-frequency response which was needed, but individual listening devices were out of the question; they would not allow lecturer and students to hear and recognize the same abnormalities without ambiguity.

The problem was solved by the school's purchase of four standard full-range AR-1x speaker systems and an AR amplifier; the latter is used with all controls "flat". Despite the large size of the lecture hall, the heart sounds are clearly audible to all students, and levels can be produced which literally rattle the doors and windows of the amphitheater.

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Only Marantz Has Gyro-

What's a Marantz?

Any audio engineer or stereo hobbyist will tell you. Marantz builds the world's finest high-fidelity components. And has for fifteen years.

This message, therefore, is not to engineers but to professional musicians, serious music-lovers, and beginning stereo hobbyists. We'd like to introduce you to Marantz.

Never Heard Of Marantz?

Until this year, the least-expensive Marantz stereo component you could buy cost $300.00. And our FM tuner alone cost $750.00! To own a Marantz, you either had to be moderately wealthy or willing to put beans on the table for awhile. But it was worth it. And a lot of experts thought so, too, because the word soon got around, and the products sold themselves.

What The Competition Said

The chief design engineer of a major competitor once said that no one even tries to compete with many of Marantz' sophisticated features; it would be just too expensive. Marantz designs its circuits the same way the aerospace industry designs missiles and jet planes—for utmost performance and reliability.

Gyro-Touch Tuning

Marantz even offers a different tuning experience because you rotate the actual tuning flywheel. This results in the smoothest, most precise tuning possible. And this Marantz-exclusive design requires considerably fewer moving parts than conventional systems used by other manufacturers. The benefits: reduced friction, wear, and service problems. We call this patented pleasure "Gyro-Touch Tuning."

Features, Not Gimmicks

The unique features of a Marantz component are there for only one purpose: to make possible the highest level of listening enjoyment.

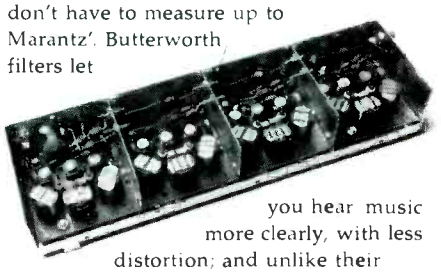
That's why we put an oscilloscope in our best components.

An oscilloscope is kind of a TV tube. But instead of the Wednesday Night Movie, it shows you a green wavy line. An electronic picture of the incoming FM radio signal, telling you exactly how to rotate your antenna for minimum multi-path distortion (ghost signals) and maximum signal strength (clarity) even from the weakest stations.

The "scope" also shows correct stereo phasing: that is, if the broadcasting transmitter or your equipment is out of phase. And it lets you set up optimum stereo performance and reception to create a solid "wall" of sound.

Butterworth Filters

You've probably never heard of Butterworth filters because practically no one else uses them besides Marantz. And the U.S. Military. Other manufacturers feel they can get by without them. And they can. Because their standards don't have to measure up to Marantz'. Butterworth filters let you hear music more clearly, with less distortion; and unlike their conventional I.F. coil or filter counterparts, they never need realignment. They help pull in distant FM stations and separate those right next to each other on the dial. Although Butterworths cost more, Marantz designed not one but four of them into their Model 18 receiver.



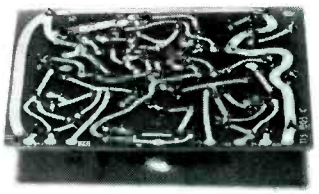
Built To Last

Marantz stereo components aren't built in the ordinary way. For example, instead of just soldering connections together with a soldering iron, Marantz uses a highly sophisticated waveflow soldering machine—the type demanded by the Military. The result: perfect, fail-

Touch Tuning!

proof connections every time.

Even our printed circuit boards are a special type—glass epoxy—built to rigid



military specifications, ensuring ruggedness and dependability.

Marantz Power Ratings Are True

When someone tells you he has a "100-watt amplifier," ask him how the power was rated. Chances are his 100 watts will shrink to about 75 or 50 or perhaps even as few as 25. The reason is that most manufacturers of stereo amplifiers measure power by an inflated "peak power" or "IHF music/dynamic power."

Marantz states its power as "RMS continuous power" because Marantz believes this is the only method of measurement that is a true, absolute, scientific indication of how much power your amplifier can put out continuously over the entire audible frequency range.

But if Marantz *were* to use the unscientific conventional method, our Model Sixteen 80-RMS-80 power amplifier could be rated as high as 320 watts per channel!

Moreover, you can depend on Marantz to perform. For example, the Marantz 80-RMS-80 amplifier can be run all day at its full power rating without distortion (except for neighbors pounding on your wall). That's power. And that's Marantz.

Marantz Speaks Louder Than Words

In a way, it's a shame we have to get even semitechnical to explain in words what is best described in the medium of sound. For, after all, Marantz is for the listener. No matter what your choice in music, you want to hear it as closely as possible to the way it was performed.

In spite of what the ads say, you can't really "bring the concert hall into your home." For one thing, your listening room is too small. Its acoustics are different. And a true concert-hall sound level (in decibels) at home would deafen you.

What Marantz does, however, is create components that most closely recreate the sounds exactly as they were played by the musical performers. Components that consistently represent "where it's at" in stereo design. No one gives you as much—in any price range—as Marantz.

Every Marantz Is Built The Same Way

Every Marantz component, regardless of price, is built with the same painstaking craftsmanship and quality materials. That's why Marantz guarantees every instrument for three full years, parts and labor.

Now In All Price Ranges

Today, there is a demand for Marantz-quality components in other than very-high price ranges. A demand made by music-lovers who want the very best but must consider their budgets. Though you can easily invest more than $2000.00 in Marantz components, we now have units starting as low as $199. True, these lower-priced models don't have all of the same features, but the quality of *every* Marantz is exactly the same. Marantz quality.

And quality is what Marantz is all about.

Hear For Yourself

So now that you *know* what makes a Marantz a Marantz, *hear* for yourself. Then let your ears make up your mind.

marantz®
Components • Speaker Systems • Receivers

these areas. The absorption coefficient of materials such as walls (brick, plaster, wood), floor (wood, tile, carpeted), draperies, and furniture (unupholstered, upholstered) are all variable; and each particular material varies in absorption coefficient from 125 Hz to 4000 Hz. Also, the number of people and how they are dressed are variables and frequency dependent.

For an average room of size 11 x 15 x 22 ft, the distance at the conductor's podium, Eq. (5) is used to determine the peak acoustic watts.

$$10 \log W = 113 - 130.5 + 28.66 = 11.66\ dB \qquad (7)$$

Solving for the acoustic power

$$W = \log^{-1}(11.6/10) = 1304\ acoustic\ watts \qquad (8)$$

The electrical power requirement of an amplifier-speaker system is shown by Table I for various SPL which can be related to Fig. 1. If one were seated 20 feet from a large orchestra, Fig. 1 shows that SPL=96 dB; then the electrical power output from the power amplifier can be low for high-efficiency speakers. However, the power amplifier may be approaching the point of high intermodulation distortion and harmonic distortion for very-low-efficiency speakers. For the acoustic room considered and the recording technique used, it can be seen that a low-efficiency speaker cannot possibly duplicate a concert orchestra at the conductor's podium. This is because power amplifiers with one kilowatt undistorted power output or even 600 watts are not available.[7] Published data[8] on low-frequency distortion for an acoustically suspended speaker are relatively high at the 20-watt level.

Damping factor (DF) is the ratio of the load impedance (normally referred to 8 ohms) to the internal source impedance of a power amplifier. A good tube amplifier may have a DF of 25. However, quality solid-state power amplifiers may have a DF of over 200; this means less than 0.04 ohms internal impedance. Any transmission line that is connected between the power amplifier and the speaker should not significantly reduce the DF. Since the speaker is an electro-mechanical device that has movement for a particular sound wave, it will have a normal

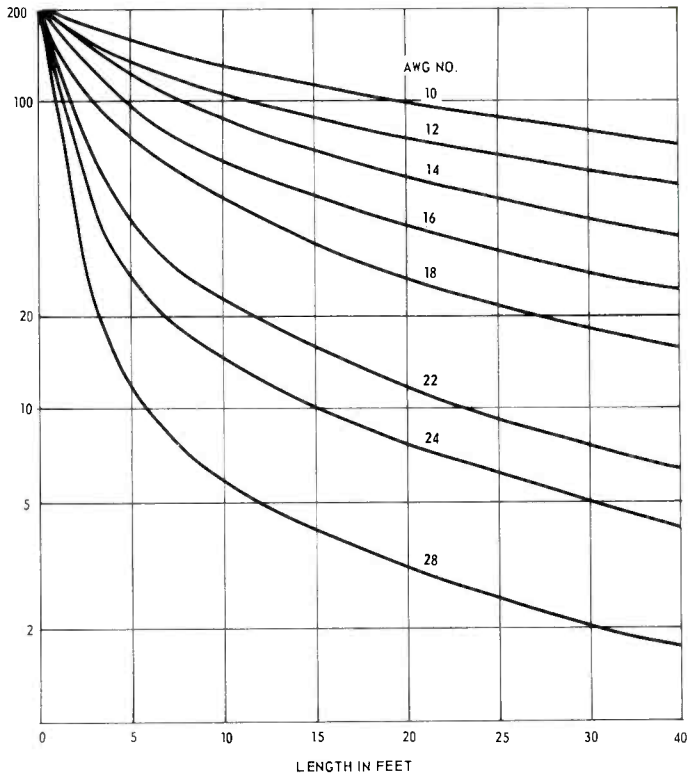


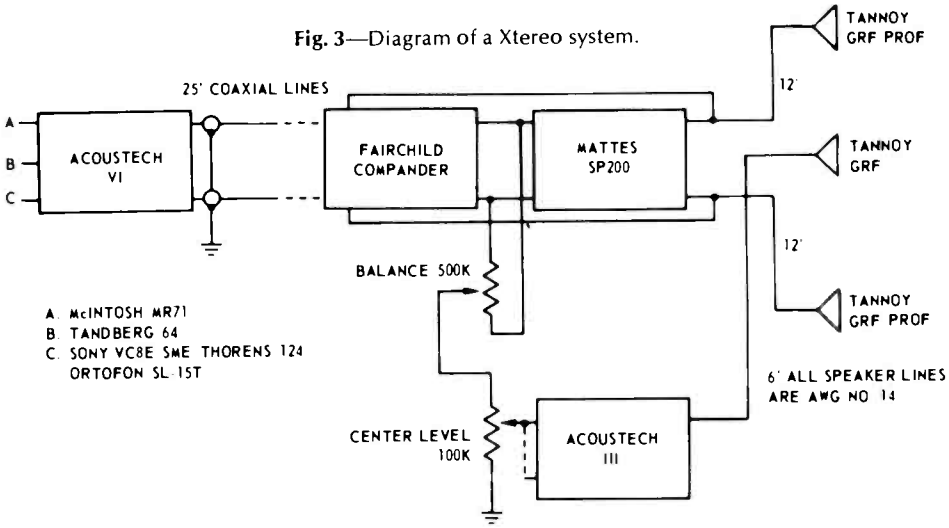
Fig. 2—How damping factor is affected by gauge and length of speaker cables.

reverse movement unless the impedance at the speaker terminals can damp out the reverse movement. If the speaker lines were of small size and/or appreciable length, this increases the effective output impedance and the designed DF is essentially lost. Figure 2 shows the effect of DF versus speaker line length for various AWG number wire. A DF of 200 is assumed for a solid-state power amplifier. It shows the importance of separate power amplifiers that are placed as close as possible to speakers with proper AWG wire and short lines.

In this respect, the physically separated preamplifier should have a low output impedance, approximately 200 ohms, with shielded signal lines. Previously, audiobuffs have stated that with high-efficiency speakers, speaker lines are not important because little power is lost in the line. This is true at low power levels and no consideration given to DF. In the low-efficiency acoustically suspended speakers where the speaker cone must move a greater distance at low frequencies, Fig. 2 is very significant.

(Continued on page 79)

Fig. 3—Diagram of a Xtereo system.



If everyone were an expert, there'd be only three speakers left on the market.

We mean this very seriously.

If everyone had a good ear without any high-frequency loss...

If everyone listened to *live* music regularly...

If everyone understood the idiosyncrasies of commercial records and tapes...

If everyone could see through shallow technical arguments...

In sum, if everyone had the qualifications of an expert judge of loudspeakers—then only three of the current models on the market would survive.

The **Rectilinear III,** the **Rectilinear Mini-III** and the **Rectilinear X.**

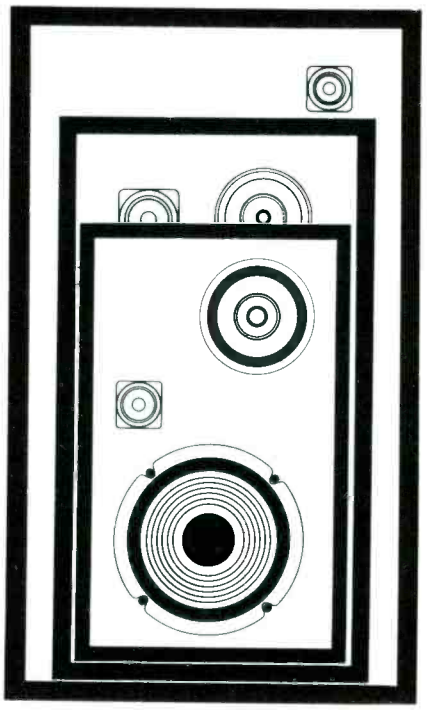
We base this brash assumption on our study of people possessing the above qualifications.

They seem to reject, to a man, all speakers created for a particular "taste." The big-bass taste. The zippy-highs taste. The Row-A-spectacular taste. Or even the more refined taste for subtly rich bass with slightly subdued upper midrange but sharply etched highs.

They want no personality at all in their speakers. Just *accuracy*. What goes in must come out, no more and no less. If the input is less than perfect, they use tone controls and filters, rather than loudspeaker manufacturers, to improve it.

And they're unimpressed by novelty for novelty's sake. They've got to *hear* that engineering breakthrough, not just read about it.

These people are invariably reduced to a choice of no more than six or seven models, out of literally hundreds. Three or four of this ridiculously small group of neutral-sounding, transparent speakers are full-range electrostatics. Which means that they're huge, awkward to place, murderously expensive and far from indestructible. Which, in turn, leaves only three, as we said:



The **Rectilinear III,** a classic after less than three years, acclaimed by every reviewer under the sun as the floor-standing monitor speaker without equal; four-way with six drivers, $279.00.

The **Rectilinear Mini-III,** the only small compact with class; three-way with three drivers, $89.50.

The **Rectilinear X,** "the world's fastest bookshelf speaker," with unprecedentedly low time delay distortion; three-way with three drivers (including our new high-excursion 10-inch woofer), $199.00.

Of course, in the real world out there, everyone is *not* an expert, so there'll be many speakers left on the market.

But there seem to be enough experts around to keep one company very happy.

(For more information, see your audio dealer or write to Rectilinear Research Corp., 30 Main St., Brooklyn, N. Y. 11201. Canada: H. Roy Gray Co. Ltd., 14 Laidlaw Blvd., Markham, Ont. Overseas: Royal Sound Co., 409 North Main St., Freeport, N. Y. 11520.)

Rectilinear

HIRSCH-HOUCK REALLY FLIPPED OVER THE NEW CONCORD MARK III

And we think you too are going to flip for the same reasons reported by Hirsch-Houck Laboratories in the January issue of *Stereo Review.* But, let Hirsch-Houck do the speaking.

"The Concord Mark III features their new pressure-sintered ferrite heads, which are claimed to have a hardness between that of a sapphire and a diamond and to be correspondingly wear-resistant: it is also claimed that they provide an extremely wide frequency response. We cannot comment on the former claim, but our tests certainly confirmed the latter."

"When we measured the overall playback-frequency response of the Concord Mark III, the advantages from its new heads were immediately apparent...we did not extend our measurements beyond 20,000Hz to check Concord's claim of 27,000Hz response: the results in the audible range were impressive enough!"

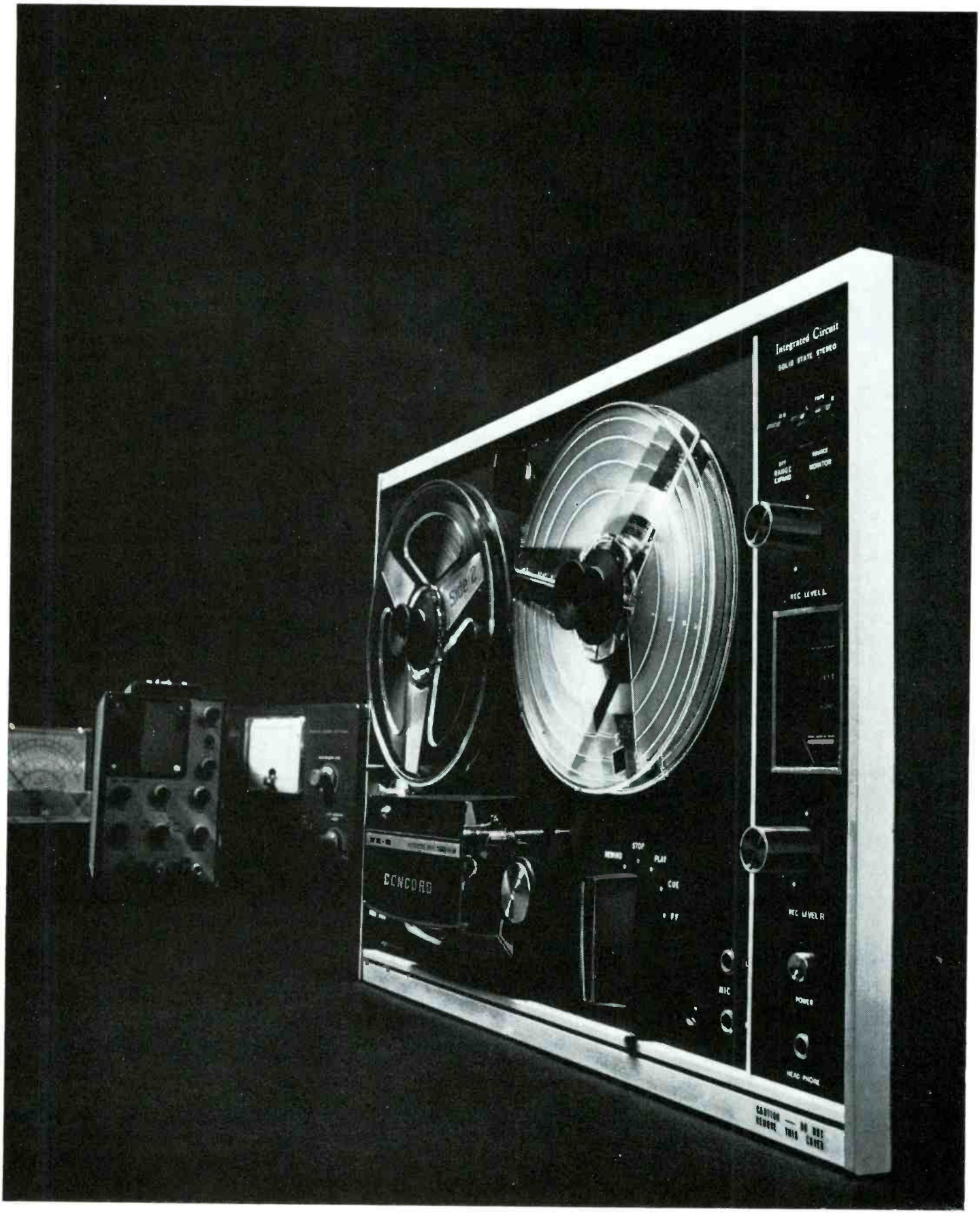
"The wow and flutter were respectively 0.015% (the residual level of our test tape) and 0.05%, among the lowest figures we have ever measured on a tape machine."

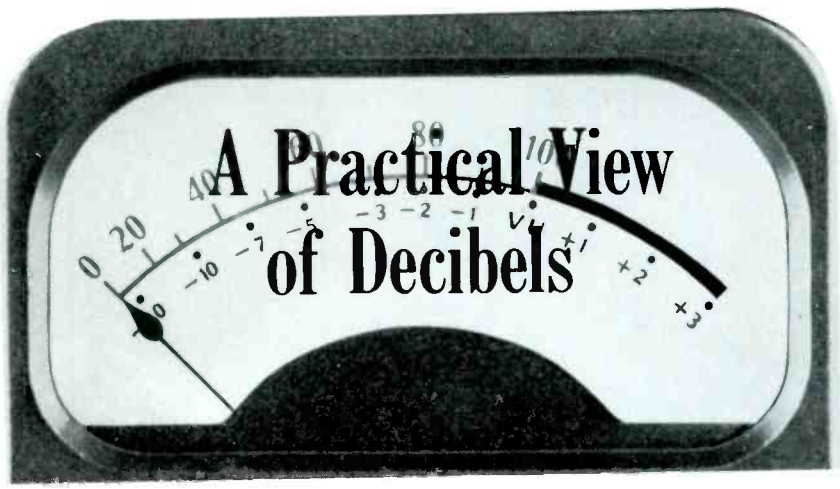
"In any event, the Concord Mark III provided one of the quietest backgrounds in the absence of signal that we have heard (or should we say "not heard"?) from a tape machine."

"In all other respects, the Mark III was equally satisfying. Its frequency response and overall cleanness of sound left little to be desired."

"The best news of all is its price—under $260. We haven't used a tape recorder at that price that could match it (if such machines do exist, we have not had the opportunity to test them)."

The Mark III, under $260, is one of a series of hysteresis-drive tape decks. The Mark II, under $230, similar in every respect except that it uses Hi-Mu laminated record and playback heads and a ferrite erase head. The Mark IV, Concord's top-of-the-line deck, similar to the Mark III, also has an extra playback head and electronic automatic reverse. Audition the new Mark Series at leading high fidelity dealers. For an "all the facts" brochure, write: Concord Electronics Corp., 1935 Armacost Avenue, Los Angeles, California 90025. Subsidiary of Ehrenreich Photo-Optical Industries, Incorporated.





GEORGE H. R. O'DONNELL

TODAY THE LACK of understanding, plus careless use of the decibel is leading to needless confusion.

Yet by a practical method shown here, proper use of these terms—dB, dBm, and VU—is easily attainable, and I believe one could obtain accurate results comparable to those laboriously obtained by customary use of the standard formulas such as:

$$dB = 10 \log_{10} P_2/P_1$$
$$dB = 20 \log_{10} E_2/E_1$$
$$dB = 20 \log_{10} I_2/I_1$$
$$P = 2^{dB/3}$$

Explanations & Observations

a) *Decibel Number (DN):* In 12 dB, it's the '12'; in 23 dB, it's the '23'.

b) Decibel Equation (DE): Such equations look like this:

12 dB = 16:1	This, a *power* equation, gives the *power* ratio.
12 dB = 4:1	This is the *voltage* or *current* ratio.

c) *Unit, Figure, Number:*

A *unit* is a natural whole: acorn, oak, forest; egg, chicken, flock; man, clan, tribe, population. They are standard statistical entities! Like eggs in a supermarket, they come small, medium, and large. There's little 'standard' about them. And it is precisely for that reason that units must be sharply defined when accuracy, precision, and maximal clarity are desired. That's why 'decibels' must be defined.

A *figure*, as used in this article and in immediate close association with the word 'number', is any one of the 10 characters, or signs, of quantity: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

A *number* is a quantity, standing alone, and made up of one or more figures. '777' is one number, but three figures. Though identical, the 7's are all different through position: the first means '700', the second '70', and the third just '7'. However, note that when used alone, we may pick individual figures out of any number: in 20 dB = 100:1, the '2' and the two 0's are directly related, as we shall see. In 120 dB = 1,000,000,000,000:1. This is the same relationship, but we'll take care to refer to the '12' as the *first part* of the decibel number. Both of these first equations provide, by mere inspection, the number of digits in their power ratios, and vice versa, so if you have the *power* ratio, you know its decibel number at once.

d) *Ratio:* In decibels, there are only two: power ratios, and voltage or current ratios. The second is always the square root of the first, or the first is the square of the second. The quantities may be any. Usually the last named ratio quantity is a '1' (obtainable by dividing both quantities by the smaller). Remember that the ratio '1:1' means only that the two quantities are identical; it does not mean that they are just '1's'; they can be '23:23', '47:47', or any other pair of identical numbers. This brings us squarely to the meaning of '0 dB', which means that there is no difference between the two quantities being described.

e) *Decibel Table (DT):* All power ratios that contain the same number of figures (no matter what the figures are) belong in the same decibel table. There are ten DE's in each table, but we give eleven, using the last of any one table as the first of the next. The decibel number of one equation in a table differs from that in the adjacent equation above or below by just 1 decibel. The first decibel number in any table is always 10 dB less than the first of an adjacent table. There is no need to learn table numbers, but if you want them too, they are always equal to the number of figures making up the power ratio. You choose the right decibel table at all times by inspection.

Given any decibel number—what is its power ratio?

Rule 1: First, divide the decibel number by 3. Since 3 dB represents twice the power ratio, the resulting quotient indicates the number of times the power must be doubled (or halved) to reach the specified decibel number. For example, what is the power ratio corresponding to 9 dB? Dividing 9 by 3 gives a quotient of 3. Thus the power must be doubled (or halved) three times, or 2x2x2, or 8 times. Therefore, 9 dB represents a power ratio of 8:1.

Rule 2: If the given decibel number is not exactly divisible by 3, add to it, or subtract from it, 1 dB. The power ratio now resulting will be either too high (if you added 1 dB) or too low (if you subtracted 1 dB). If it is too high, decrease the power ratio by one-fifth; if too low, increase it by one-fourth. For example, what is the power ratio corresponding to 13 dB. From Rule 1, we can learn that 12 dB = 16:1 (12/3 = 4; 2x2x2x2 = 16). The '16' is obviously too small; increased by one fourth it becomes 16 + 4 = 20; so 13 dB = 20:1.

Now we apply this Rule to derive the first and basic decibel table, by getting at it backwards. If 9 dB = 8:1, 10 dB will be one-fourth more, or 10:1. We already have 9 dB equalling 8:1, and 8 dB—one less than 9—requires taking one-fifth less than 8:1. Thus, one-fifth of 8 = 1.6, and 8 − 1.6 = 6.4, so 8 dB represents a power ratio of 6.4:1.

People prefer its sound to $100 headphones.

People prefer its feel to earmuffs.

Before the very recent introduction of the Fisher HP-100, headphones to most people meant:

A device for listening to music for short periods of time.

A frequency response considerably more restricted than that of speakers.

A boxed-in, isolated-from-the-world feeling.

Needless to say, we wouldn't be reminding you of the problems involved in headphone listening if we hadn't already solved them.

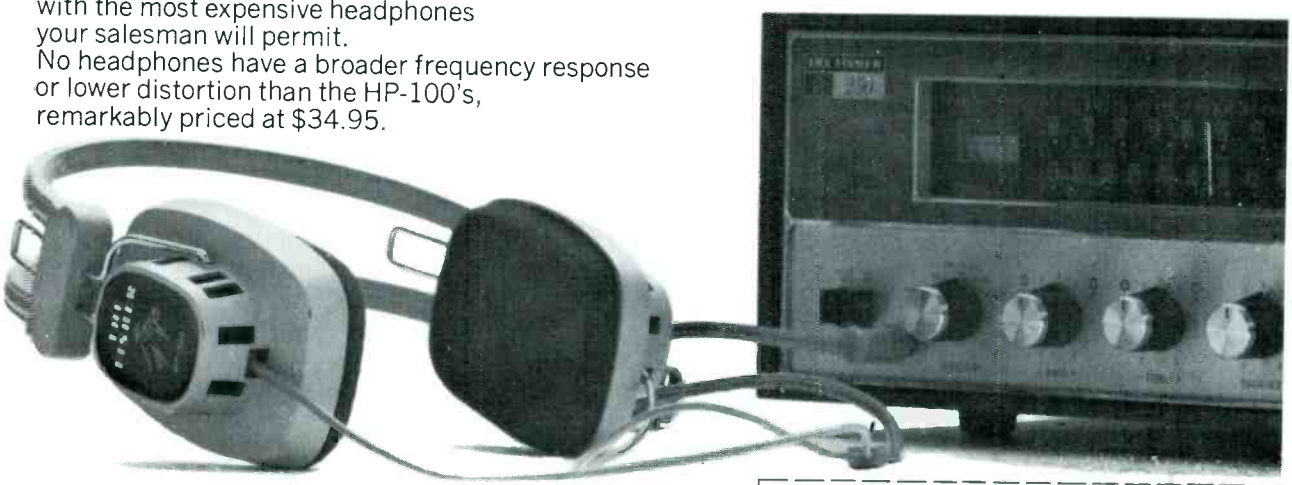
With the Fisher HP-100 you can listen all night, and all the next day if you want to, in absolute comfort. Nothing touches your ears but velvet-soft foam rubber, kept in place by pressure too light to feel after the first minute or so.

How does it shut out all external sounds?

It doesn't.

If the phone rings you'll hear it. Just as you would if you were listening to speakers.

As for sound, we invite comparison with the most expensive headphones your salesman will permit. No headphones have a broader frequency response or lower distortion than the HP-100's, remarkably priced at $34.95.



The Fisher®

Mail this coupon for your free copy of The Fisher Handbook, 1970 edition. This reference guide to hi-fi and stereo also includes detailed information on all Fisher components.

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Rule 3: Adding 3 dB to any decibel equation doubles the power ratio; subtracting 3 dB halves the power ratio. Thus, if 10 dB represents a power ratio of 10:1 (Rule 2) then 10−3 or 7 dB represents a power ratio of 5:1. Similarly, if 6 dB=4:1, 3 dB=2:1. If 3 dB=2:1, then 0 dB=1:1.

From this we see that there is a difference of 0 dB between two signals, they are of exactly the same level, and that's what dB are all about. They always represent a *ratio*, and as such are a logarithmic quantity. And logarithms scare most people.

We now present the first and basic decibel table (the left column). And alongside it are the next two decibel tables, showing how the values progress, each by a factor of 10.

THE BASIC DECIBEL TABLE

dB	Power ratio	dB	Power ratio	dB	Power ratio
0	1:1	10	10:1	20	100:1
1	1.25:1	11	12.5:1	21	125:1
2	1.6:1	12	16:1	22	160:1
3	2:1	13	20:1	23	200:1
4	2.5:1	14	25:1	24	250:1
5	3.2:1	15	32:1	25	320:1
6	4:1	16	40:1	26	400:1
7	5:1	17	50:1	27	500:1
8	6.4:1	18	64:1	28	640:1
9	8:1	19	80:1	29	800:1
10	10:1	20	100:1	30	1000:1

Note: The second equation power ratio (1.25:1) gives the ratio 5/4:1, and is the basis for another rule.) For example, 5/4x5/4x5/4=125/64=2:1. Thus the '5' and the '4' are special. Whenever you come across either of these figures, you are to double the '6-4' to a 1-2-5, and halve any 1-2-5 into a 6-4. That is the price our method pays for using 1.25:1 instead of 1.2589:1 (for 1 dB).

Rule 4: To add any two decibel equations, add only their decibel numbers, but multiply their *power* ratios (never their voltage or current ratios). To subtract any two decibel equations, subtract only their decibel numbers, but divide their corresponding power ratios. For example:

12 dB=16:1	12 dB=16:1
+3 dB= 2:1	−9 dB= 8:1
15 dB=32:1	3 db= 2:1

These examples, and those given previously, are obviously only one method by which, using the basic table, any higher or lower equation can be built up. For instance, given the power ratio 256:1; what is its decimal number? From the basic table, the nearest multiple to 256 is 2.5:1 (4 dB). The *three* figures in the '256' indicate that your multiplier must be '100' (20 dB). Then you have two equations to add:

20 dB=100:1
4 dB= 2.5:1
24 dB=250:1 (which is close enough since the correct number of dB is 24.082.)

Voltage & current ratios

Now that you can solve the power ratio easily, you will want to know how to determine voltage or current ratios, so we come to Rule 5: Having any power ratio, take its square root to have the corresponding voltage or current ratio. For example:

dB	Power ratio	Current or Voltage ratio
6	4:1	2:1
12	16:1	4:1
14	25:1	5:1
18	64:1	8:1
20	100:1	10:1
30	1,000:1	32:1
60	1,000,000:1	1000:1
70	10,000,000:1	3200:1

The dBm

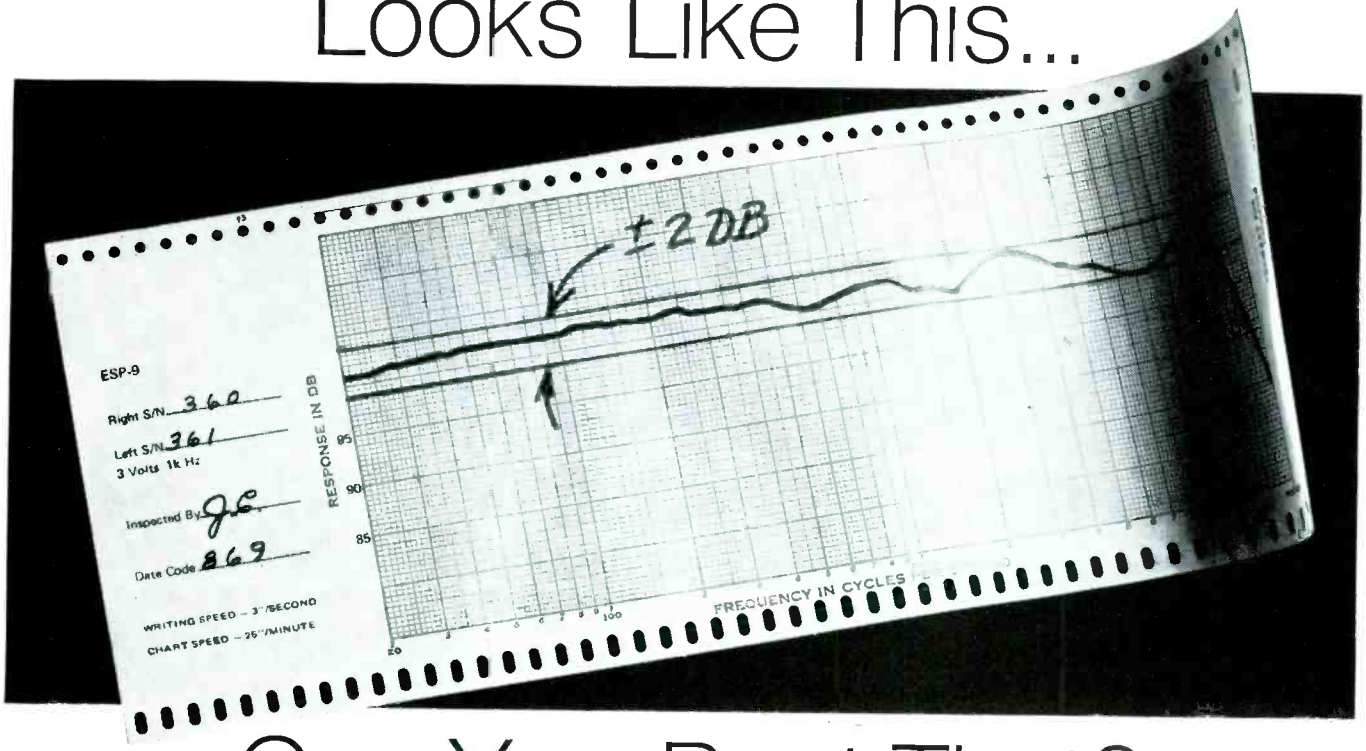
Since the dB is now established as a *ratio*, and only as a ratio, if a given level is to be indicated by a decibel number, it must be referenced to some standard level. And since the usual reference level used professionally in transmission of audio signals is referred to as '1 milliwatt across 600 ohms,' the chosen reference becomes that same '1 milliwatt', and the term dBm is created, with the 'm' standing for the milliwatt. Thus a reference to a level of +8 dBm now means something. The actual level indicated by +8 dBm means that it is 8 dB above 1 milliwatt across 600 ohms. It's as simple as that. While heretofore we had a ratio, we now have a ratio referred to a specified quantity, and we are no longer saying that something is three times as long, for example, but instead we are saying that a level is three times as great as a fixed level, which corresponds to an increase of about 5 dB.

The Volume Unit (VU)

The VU is based on the same scale of values, but when a program is specified as having a level of +4VU, it means two distinct things: (1) it is referenced to a level of 1 milliwatt in 600 ohms, and (2) it is measured on program material (not sine waves) with a meter having specified characteristics. Among these characteristics are its resistance (3900 ohms), its ballistic characteristics (the pointer must reach 99 per cent of its final deflection to an applied signal in 0.3 seconds, and its overswing shall be between 1.0 and 1.5 per cent when the tone is applied).

The standard VU meter has a yellow dial and is normally illuminated for use in recording and broadcast studios. Its rectifier characteristics are also specified. Thus it will be noted that not all meters that are labelled "VU" are actually VU meters, even though they may have yellow dials. They do, however, serve to give the user a reference indication of the signal level in a manner that is useful in recording and broadcast applications. After some use of a specific instrument, the operator will become sufficiently familiar with its characteristics so that his recordings or his station output are consistent from program to program. For a more thorough treatise on the VU meter and its applications, the reader is referred to "The Measurement of Audio Volume," by Howard Chinn, which appeared in the September and October, 1951, issues of AUDIO, and to "Volume Measurements of Electrical Speech and Program Waves, American Standards Association, C-16.5 (1942). Æ

The Sound Of KOSS Looks Like This...



Can You Beat That?

To guarantee performance to specifications, this individual machine-run response curve comes with every ESP-9 Studio Monitor Headset. You get, for the first time, flat ± 2 db monitoring over the entire audible spectrum because the ESP-9 is a breakthrough electro-acoustical development achieved by exploiting electrostatic principles. Only Koss electrostatics give push-pull balanced acoustical circuitry, cancelling all second harmonic distortion to provide fatigue-free listening through long recording sessions. Now you hear what the program material *really* sounds like, uncolored by monitor room reflections. Exceeding the range and cleanliness of any speaker system, the ESP-9 gives the measure of separation and accurately positions the soloist. 40 db isolation through comfortable, fluid-filled cushions relieves the noisy distraction caused by producers, A and R men, time-killing artists, and other visitors in the control room. The ESP-9 eliminates the masking effect of blowers, breath sounds, clothes rustling and other control room ambients. So now you have a running check on low-level system noise. You monitor the sounds you only *saw* before on the VU meter, like the "whoosh" of a stage door closing, ventilator rumbles and music stand rattles — because speakers simply don't have the super-wide-range you need to hear them.

The ESP-9 has a signal handling capacity of 10 volts at 30 Hz with good wave form versus 6 volts for the integrated ESP-6 introduced last year. This is made possible by increasing the size of the coupling transformers by a factor of 4 and mounting them in the E-9 Energizer external to the cup.

The E-9 Energizer offers the option of self-energizing for the bias supply, or energizing through the ac line; choice is made with a selector switch on the front panel. When energized through the ac line, very precise level measurements can be made. Thus the unit is ideal for audiometry, and for evaluating the spectral character of very low level noise in tape mastering machines and recording consoles.

SPECIFICATIONS

Frequency Response Range, Typical: 15-15,000 Hz ± 2 db (10 octaves) 10-19,000 Hz ± 5 db. An individual, machine-run calibration curve accompanies each headset. Sensitivity: 90 db SPL at 1kHz. ± 1 db referred to 0.0002 dynes/cm² with 1 volt at the input. Total Harmonic Distortion: Less than ⅕ of 1% at 110 db SPL. Isolation From External Noise: 40 db average through fluid-filled cushions provided as an integral part of the headset. Power Handling Capability: Maximum continuous program material should not exceed 10 volts (12 watts) as read by an ac VTVM; provides for transient peaks 14 db beyond the continuous level of 10 volts. Source Impedance: Designed to work from 4-16 ohm amplifier outputs. External Power Requirements: None, except when used for precise low level signal measurement, when external ac line can be selected by a front panel switch on the E-9 Energizer.

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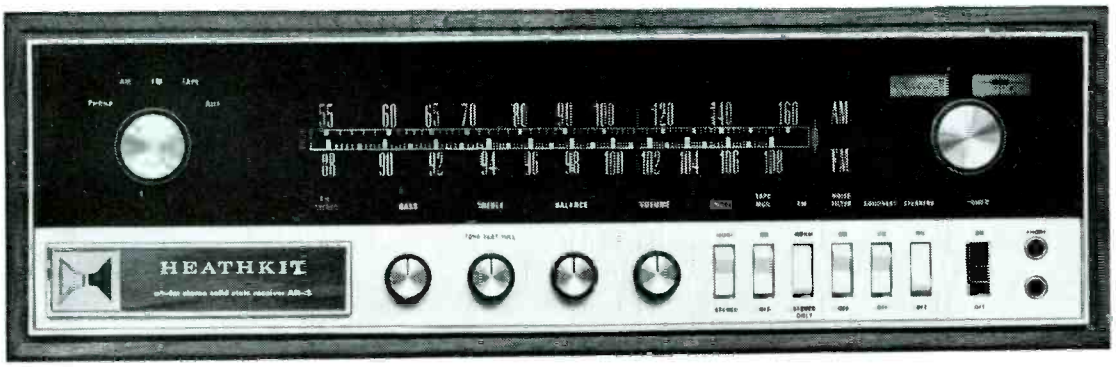
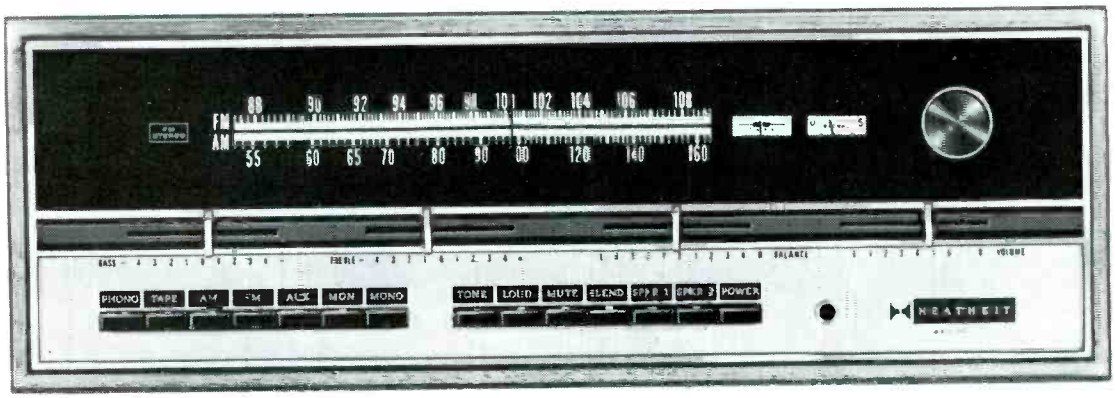
Until Now There Has Been One Stereo Receiver Obviously Superior To All Others— The Heathkit® AR-15

Now There Are Three

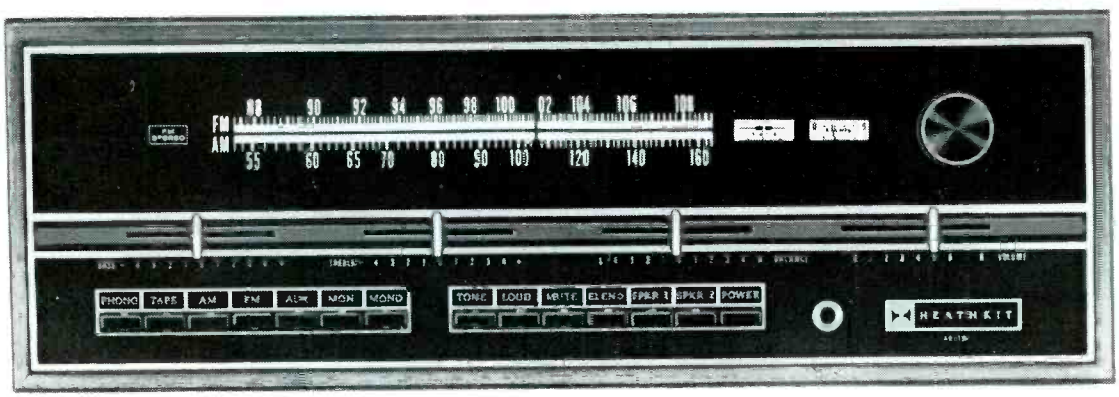
1. Heathkit® AR-15



2. Heathkit® AR-29



3. Heathkit® AR-19



—150 Watt AM/FM/FM Stereo Receiver

The receiver that started the trend to new concepts in circuitry is still judged the world's finest . . . by owners, electronic experts and testing labs. Here are some of the many reasons why. The AR-15 delivers 150 watts music power from its 69 transistor, 43 diode, 2 IC's circuit — 75 watts per channel. Harmonic and IM distortion are both less than 0.5% at full output. The FM tuner has a cascode 2-stage FET RF amplifier and an FET mixer to provide high overload capability, excellent cross modulation and image rejection. The use of two crystal filters in the IF section is a Heath first in the industry and provides an ideally shaped bandpass and adjacent channel selectivity impossible with conventional methods. Two Integrated Circuits in the IF amplifier provide hard limiting, excellent temperature stability and increased reliability. The FM tuner boasts sensitivity of 1.8 uV, selectivity of 70 dB and harmonic & IM distortion both less than 0.5% . . . you'll hear stations you didn't even know existed, and the elaborate noise-operated squelch, adjustable phase control, stereo threshold control and FM stereo noise filter will let you hear them in the clearest, most natural way possible. Other features include two front panel stereo headphone jacks, positive circuit protection, transformerless outputs, loudness switch, stereo only switch, front panel input level controls, recessed outputs, Tone Flat control, a massive electronically filtered power supply and "Black Magic" panel lighting. Whether you choose the kit model or the factory assembled and tested version, you have chosen the world's finest stereo receiver . . . the Heathkit AR-15.

Kit AR-15, (less cabinet), 34 lbs. **$349.95***
Assembled ARW-15, (less cabinet), 34 lbs. **$540.00***
Assembled AE-16, optional walnut cabinet, 10 lbs. **$24.95***

—100 Watt AM/FM/FM Stereo Receiver

The world's finest medium power stereo receiver . . . designed in the tradition of the famous Heathkit AR-15. It's all solid-state . . . 65 transistors, 42 diodes plus 4 integrated circuits containing another 56 transistors and 24 diodes. Music power output at 8 ohms is 100 watts. Frequency response is 7 to 60,000 Hz. Harmonic Distortion is less than 0.25% and IM Distortion is 0.2% — both ratings at full power. Direct coupled outputs are protected by dissipation-limiting circuitry. It boasts a massive, electronically regulated power supply. Circuitry includes four individually heat sinked output transistors. The AR-29 uses linear motion bass, treble, balance and volume controls and pushbutton selected inputs. There are outputs for two separate stereo speaker systems, it has center channel capability and a front panel stereo headphone jack. The FET FM tuner is assembled and aligned at the factory and has 1.8 uV sensitivity. Two front panel tuning meters make precise tuning easy. A computer designed 9-pole L-C filter plus 3 IC's in the IF give ideally shaped bandpass with greater than 70 dB selectivity and eliminates alignment. IC multiplex section. The AM tuner has three FET's. An AM rod antenna swivels for best pickup. Modular Plug-in Circuit Boards make the kit easy to build and service. Built-in test circuitry lets you assemble, test and service your AR-29 without external test equipment. "Black Magic" panel lighting, chrome trim, aluminum lower panel. The AR-29 will please even the most discriminating stereo listener in performance and value.

Kit AR-29, (less cabinet), 33 lbs. **$285.00***
Assembled AE-19, oiled pecan cabinet, 10 lbs. **$19.95***

—60 Watt AM/FM/FM Stereo Receiver

The AR-19 circuitry reflects many of the advanced concepts of the AR-29. It uses 108 transistors and 45 diodes including those in 5 integrated circuits. It delivers 60 watts music power at 8 ohms. At any power level, Harmonic and IM Distortion is less than 0.25%. Frequency response ranges from 6 to 35,000 Hz. Direct coupled outputs are protected by dissipation-limiting circuitry. A massive power supply includes a section of electronically regulated power. The assembled, aligned FET FM tuner has 2.0 uV sensitivity. A preassembled and factory aligned FM IF circuit board gives 35 dB selectivity. The multiplex IC circuit provides inherent SCA rejection. It features two switched noise muting circuits; linear motion controls for bass, treble, volume and balance; input level controls; outputs for 2 separate stereo speaker systems; center speaker capability; two tuning meters; stereo indicator light; front panel stereo headphone jack. The Modular Plug-in Circuit Board design speeds assembly. Built-in Test Circuitry aids assembly, simplifies servicing. "Black Magic" panel lighting, black lower panel, chrome accents. Compare it with any model in its price range . . . the AR-19 will prove itself the better buy.

Kit AR-19, (less cabinet) 29 lbs. **$225.00***
Assembled AE-19, cabinet, 10 lbs. **$19.95***

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"An Integrated Circuit FM Detector"

EUGENE T. PATRONIS, JR.

INTEGRATED CIRCUITS ARE BEGINNING to bring about extraordinary changes in the electronics industry. These changes are manifested in many ways. The radical differences in the manufacturing processes of integrated circuits as compared with circuits assembled from discrete components are self-evident. In addition, however, there are notable differences in circuit capabilities and in design considerations as well. In general, integrated circuits have a higher circuit density, greater speed, and lower power dissipation than conventional circuits. They lend themselves quite readily to those applications where a large number of circuits of a particular type are required as in computer circuitry. They are finding increasing use in linear circuits where the applications can be tailored to a few standard configurations. RCA, GE, Fairchild, and Texas Instruments among others are each producing lines of linear integrated circuits. Circuit designers will be called upon more and more in the future to design around a few standard integrated circuits or to evolve circuits which can be totally reduced to the integrated form so as to reduce overall costs. An example of a circuit-design innovation which allows a frequency-modulation detector to be produced completely as an integrated circuit will be given here.

Frequency-modulation detectors usually take the form of a limiter-discriminator or ratio detector. Both of these circuits depend in part upon a tuned transformer for their operation. The other components in these circuits such as transistors, resistors, diodes, and capacitors can all be produced in the IC form. The transformer can not be integrated at the present stage of IC technology. A circuit not requiring a transformer or other inductors would allow the detector to be produced completely in the integrated form. Clearly, the transformer must be eliminated.

In order to see how this may be accomplished, consider the function which must be performed by the detector. When the detector is presented with a signal whose frequency is f_o, the output of the detector is to be zero, When the detector is presented with a signal whose frequency is f, the output of the detector is to be a voltage whose value is proportional to Δf where

$$\Delta f = f - f_o \qquad (1)$$

In most applications Δf is no greater than one per cent of f_o. The fact that the detector output is zero when the input is at a frequency of f_o is suggestive of a null or balance technique. That is, if two signals, say A and B, can be derived from the input signal in such a way that their amplitudes are equal at the frequency f_o, then the difference of these two signals will be zero at the frequency f_o. Furthermore, if the amplitude of A is an increasing function of f while the amplitude of B is a decreasing function of f, then the amplitude of the difference signal A−B contains information about Δf.

Let the input signal to the detector be a constant-amplitude sine wave denoted by

$$e_i = E \sin(2\pi ft). \qquad (2)$$

From this signal must be derived the two signals A and B. The amplitude of signal A must be an increasing function of f. It is a well-known property of sinusoids that the time derivative is proportional to f. The amplitude of signal B must be a decreasing function of f. This can be given by the time integral of the sinusoid which is inversely proportional to f. Apparently, the signals A and B can be derived from the input signal e_i by the operations of differentiation and integration, respectively. These operations can be performed electronically with great accuracy by means of operational amplifiers which can be constructed in the form of completely integrated circuits.

Figure 1 depicts a detector circuit arranged according to the considerations just discussed. The triangles represent inverting amplifiers having large voltage gains for frequencies in the vicinity of f_o. The generator represents a frequency-modulated signal source of the form

$$e_i = E \sin(2\pi ft). \qquad (3)$$

The operational differentiator produces an output signal e_A of the form

$$e_A = -RC2\pi f\, E \cos(2\pi ft) \qquad (4)$$

which when rectified by the diode D_A and filtered by the network R_L and C_L becomes E_A where

$$E_A = \eta RC2\pi f\, E, \qquad (5)$$

η being the rectification efficiency. The operational integrator produces an output signal e_B of the form

$$e_B = \frac{E}{RC2\pi f} \cos(2\pi ft) \qquad (6)$$

which when rectified by the diode D_B and filtered by the network R_L and C_L becomes E_B where

$$E_B = -\frac{\eta E}{RC2\pi f}, \qquad (7)$$

assuming the same rectification efficiency. The output of the overall detector is then e_o with

$$e_o = \eta E \left(RC2\pi f - \frac{1}{RC2\pi f} \right). \qquad (8)$$

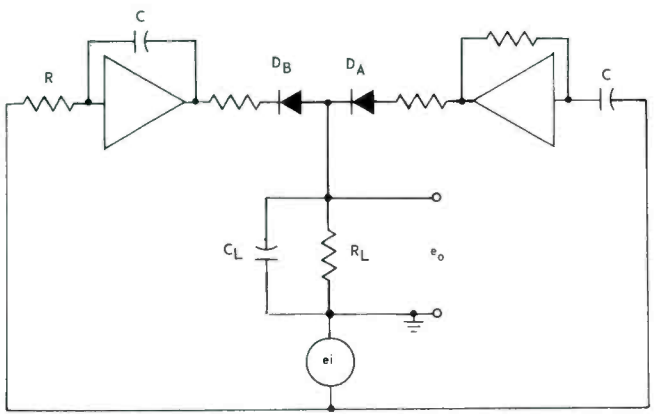


Fig. 1—Circuit proposed by the author for use as a frequency-modulation detector.

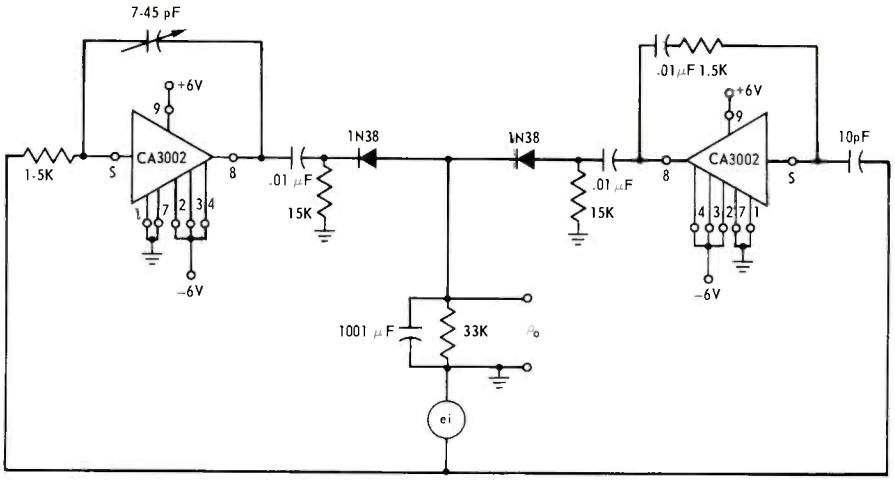


Fig. 2—Details of the final circuit using RCA integrated circuits—CA-3002s—as a complete frequency-modulation detector. Constants shown are for an i.f. of 10.7 MHz.

If now the integration and differentiation time constant RC is chosen so that

$$RC=\frac{1}{2\pi f_o} \qquad (9)$$

and remembering that

$$f=f_o+\Delta f$$

with

$$|\Delta f| \ll f_o,$$

then the output of the detector becomes

$$e_o=\eta\, E\, 2\frac{\Delta f}{f_o}, \qquad (15)^*$$

which is just the desired form. Even though the analysis has been carried out assuming that the signal to be detected is sinusoidal, this assumption is not essential. The input signal might just as well be a square wave, a triangular wave, or other periodic waveshape having an average value of zero. The A signal will still be proportional to the frequency while the B signal will still be inversely proportional to the frequency.

This detector offers a number of advantages other than the fact that it can be constructed completely in the integrated form. The operational amplifiers provide excellent isolation between the signal source and the detector load. The detector can readily be tuned by varying the time constant RC. This tuning could be accomplished remotely under voltage control by letting C be furnished by a silicon varactor diode, for example. The detector can be used with a wide variety of signal waveshapes and over a wide range of frequencies, f_o.

*The derivation of (15) from (8) appears in the appendix.

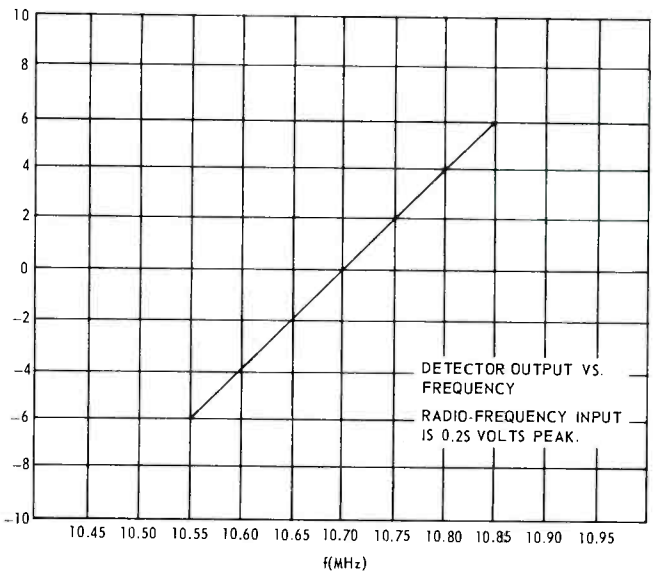


Fig. 3 — Curve of detector output vs. frequency. Radio-frequency input is 0.25 volts peak.

While it is understood that the entire circuit would be feasible in a single IC chip, none is yet available. However, the author assembled the same circuit functions, using a pair of RCA integrated circuits (commonly available at a price of about $4.40 each in small lots) each as the operational amplifiers. The complete circuit of the FM detector developed is shown in Fig. 2, with constants suitable for an i.f. of 10.7 MHz. This circuit, working from an i.f. input of 0.25 V applied at e_i produced an output as shown in the diagram of Fig. 3, where e_o was measured at −6.2 mV for an applied frequency 150 kHz lower than f_o and +6.2 mV when the applied frequency was 150 kHz higher than f_o. Note that the curve has exceptional linearity over a swing of ±250 kHz each side of the center frequency.

Further development of the circuitry —and the possible introduction of an IC designed for this particular application—would certainly simplify FM receivers and their alignment, an aim that is always justified in this day of electronic simplification. **AE**

APPENDIX

To further clarify the derivation of (15) from (8), the following is offered:

$$e_o=\eta\, E\left(RC2\pi f-\frac{1}{RC2\pi f}\right) \qquad (8)$$

Let $RC=\frac{1}{2\pi f_o}$; then

$$e_o=\eta\, E\left(\frac{f}{f_o}-\frac{f_o}{f}\right) \text{or} \qquad (10)$$

$$e_o=\eta\, E\left(\frac{f^2-f_o^2}{f_o f}\right) \qquad (11)$$

Substitute $f=f_o+\Delta f$ to obtain

$$e_o=\eta\, E\left(\frac{[f_o+\Delta f]^2-f_o^2}{[f_o+\Delta f]f_o}\right) \qquad (12)$$

$$e_o=\eta\, E\left(\frac{f_o^2+2f_o\Delta f+\Delta f^2-f_o^2}{f_o^2+f_o\Delta f}\right) \qquad (13)$$

$$e_o=\eta\, E\left(\frac{2f_o\Delta f+\Delta f^2}{f_o^2+f_o\Delta f}\right) \qquad (14)$$

In the numerator, Δf^2 is much smaller than $2f_o\Delta f$; therefore we neglect it. In the denominator, $f_o\Delta f$ is much smaller than f_o^2, so we neglect $f_o\Delta f$. Therefore with very small error:

$$e_o=\eta\, E\left(\frac{2f_o\Delta f}{f_o^2}\right)=\eta\, E\left(\frac{2\Delta f}{f_o}\right) \qquad (15)$$

Equipment Profiles

This Month:

- Roberts Stereo Tape Recorder, Model 420XD
- Dynaco Stereo 80 Power Amplifier Kit
- Harman-Kardon Model 820 Stereo Receiver
- Jensen TF-25 Loudspeaker System
- Pioneer SE-50 Two-Way Stereo Headphones

Roberts Stereo Tape Recorder Model 420 XD

MANUFACTURER'S SPECIFICATIONS:
Frequency Response: 30 to 22,000 Hz ±3 dB at 7½ ips. **Tape Speeds:** 1⅞, 3¾, 7½, and 15 ips. **S/N:** 50 dB. **Wow and Flutter:** 0.12% at 7½; 0.17% at 3¾; 0.20% at 1⅞. **Outputs:** two preamp "line" outputs and 8-ohm stereo headphone jack. **Heads:** Erase, Record, Playback, and Cross-field head for bias; 2 micron (.000080") head gap on record and x 10½" d. **Weight:** 55 lbs. **Price:** $699.95.

The Roberts 420SD is actually a deck, in that it does not have a built-in power amplifier and speakers, nor does it have any provision for speakers. You must connect it to another amplifier if you wish to hear the results on other than headphones. For thoses who require a built-in amplifier and speakers, there is another model—420X—which does incorporate these features, and which costs an additional $100.00. Otherwise, the two models are identical except for weight—the 420X weighs 61½ lbs.

The unit comes in an attractive wood housing, complete with a removable cover. It is designed for vertical operation, and accommodates 7-in. reels. The hubs are fitted with spring-loaded retainers on both shafts. A cutout on the right side of the case gives access to the input and line-output phono jacks, as well as to a "DIN" type 4-terminal socket which is used with many amplifiers to provide input and output connections with a single plug.

Fig. 1—Roberts Model 420XD Tape Recorder—a deck with auto reverse, four speeds, and a host of other features in one machine.

The mechanism is relay operated, with light-touch push buttons controlling all transport functions. Tape speed is selected by push buttons, as is the mode of operation—tracks 1 and 4, stereo, or tracks 2 and 3. Headphone and microphone jacks are located along the lower edge of the front panel, with a headphone level control just above the headphone jack at the lower left corner. Above this is the TAPE/SOURCE pushbutton assembly for monitor, and to the right are the record-level controls. These are dual-concentric, one pair for each channel. The front metal knob controls microphone level, while the black plastic knob at the rear controls the AUX input level. Between these two controls is the record push button, and above it, the record indicator light. Below it a unique feature: the Comput-O-matic Record Level Indicator. This device provides an unusual type of automatic level control. With the enabling button depressed during the recording of a number, the circuit mechanically rotates a volume control so that the loudest note recorded will be reduced to the proper recording level, and all other material thereafter will be recorded in equal proportion to the level set automatically for the loudest note or passage. This is auxiliary to the manual recording-level controls, and functions only when the Comput-O-Matic SET button is depressed. If the button is not depressed, the job of controlling the recording level is done manually by the operator. A small indicator shows the position of the automatic control in what appears to be a knob—at maximum, it is in the position usually occupied by a manual knob in the maximum position—that is, at about 5 o'clock. This feature is particularly helpful to the inexperienced user, since he is more likely to produce usuable recordings than he could with only manual control.

The 420XD is a reversible machine, and this entails the need for more than the usual four push buttons for operation—or five, if you include the RECORD button. The row of push buttons which control the tape motion incorporates five buttons — REWIND, REVERSE, STOP, FORWARD, and FAST FWD. All of these control relays—

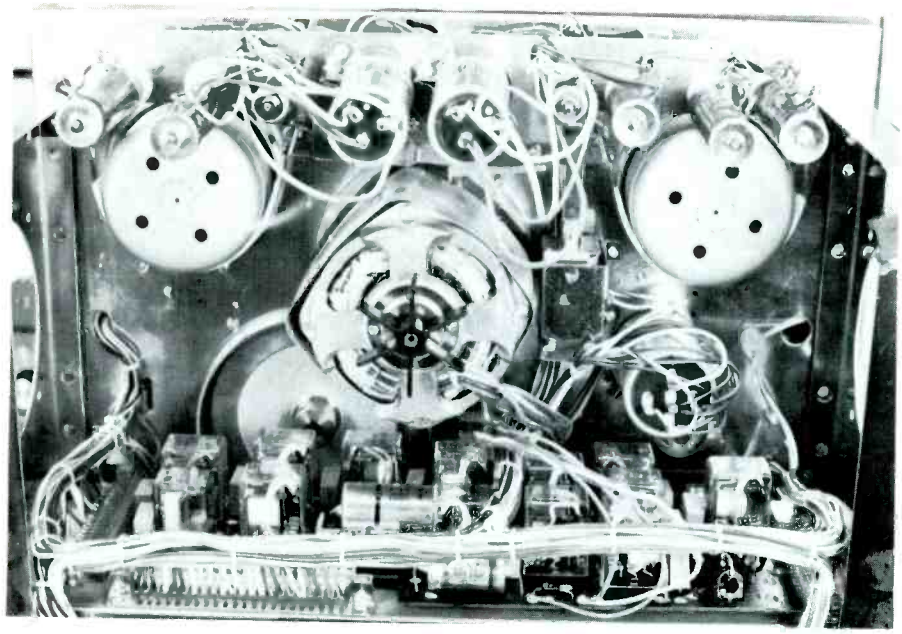


Fig. 2—This shelf in the Roberts recorder carries the many relays which control the functioning of the machine at the command of a series of push buttons.

thirteen of them, as near as we could count—and solenoids, of which there are three. This is understandable, considering the number of functions which are controlled, and the combinations of these functions, which would be difficult for full manual control without the combinations.

The reversing process involves changing the direction of motor operation, reversing the duties of the spooling motors, and shifting the play head (the reverse function operates only on playback, not on recording). During recording, the Cross-Field head is raised up to a position about .05 in. from the record head, and the bias is applied from the back of the tape. This system seems to improve the high-frequency response of the recorded signal, particularly at the slower speeds. When the recorder is at rest or in the playback mode, the cross-field head is away from the record head, as seen in the illustrations, so that tape threading can be accomplished readily without the interference of the additional head.

Another useful circuit in the unit is one called the "Head Sentry." It taps off the signal from the input transistor in the playback amplifier and feeds it through a string of transistor stages which are tuned to a high frequency. If the heads—play or record—become coated with residue from the tape or if they are only dirty, the high-frequency content of the signal is appreciably reduced, and the circuit causes the sentry lamp to light, thus indicating that the heads should be cleaned before continuing.

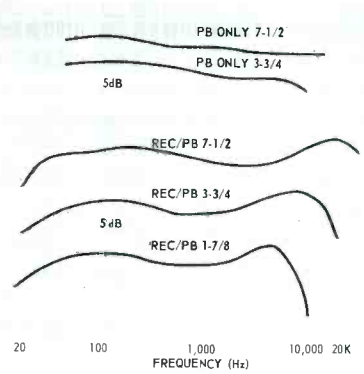
Still another feature — this one purely mechanical—is the selection of the point where the reversal of tape motion takes place. If only a part of a reel is recorded—as would be the case if the selection were not long enough to fill one side of the reel—the Reverse-O-Matic control can be set to reverse at that point, rather than waiting until the entire side had been played. A knob at the top of the panel operates over a scale calibrated in 100-foot increments, and this knob is set to the footage at which the reverse is to take place. When that amount of footage has passed through the machine, the unit reverses itself automatically. It is also possible to inaugurate the reverse action by affixing a strip of conductive foil to the tape at the point where it is to reverse. The control by the mechanism is put into action by depressing the Reverse-O-Matic SET button. As the tape is returned to the left reel, the scale will show the numbers reducing to zero, and at this point the machine will reverse again, playing in the forward direction. Thus continuous playing can be employed if desired.

Two other unusual features are the selection of brake tension for three different thicknesses of tape—standard or 1½-mil, 1.0-mil, and 0.5-mil —and the changeover from 60 to 50 Hz line supply. This latter control simply moves the main belt from one pair of pulleys to another. This makes it possible for the machine to be used in the U.S.A., where 60 Hz is the standard line frequency almost everywhere, or in the rest of the world where 50 Hz is the standard.

The tape is threaded over the damping lever and around an impedance roller at the left of the head assembly, then past the tape cleaner (which may be moved upward slightly for use with virgin tapes which do not need cleaning) past the heads and then under the capstan (this is, over the pinch roller), under the automatic stop lever and onto the take-up reel. The machine will not run unless the tape holds the automatic lever up and thus away from the cutoff switch. A knob adjacent to this lever holds it away from the main power cutoff Microswitch during normal operation, but if it is desired to have the entire machine shut off—amplifiers as well as motors—the knob is turned slightly to the left so as to allow the shutoff lever to drop down fully and contact the second switch, which shuts off all the power to the unit.

From this description it can be seen that the machine is full of a number of fine features which simplify operation, make is as flexible as possible, and provide practically any function the recordist may want.

Fig. 3—Playback response from standard tapes at 7½ and 3¾ ips, and record/play responses for these speeds and for 1⅞ ips in addition.



Performance

The 420XD comes fairly close to its specifications. Frequency response in playback from standard tapes is

shown in Fig. 3, along with the record/play responses for the three slower speeds. We did not make any tests at the 15-ips speed because it appeared that there was some oscillation in the circuit. Signal-to-noise measured 48 dB below the 3% distortion point, which was at 10 dB above the indicated zero on the VU meters—both of which, by the way have only a single white line to indicate the "zero," and no other scale marking. Wow and flutter measurements were well below the specifications with figures of .08 per cent at 7½ ips, 0.11 at 3¾, and 0.17 at 1⅞. Distortion was under 1 per cent at "0" recording level, and reached 3 per cent only at a +10 level. The tape used was Scotch 111.

The input signal required to reach a "0" recording level was less than 0.3 mV in the microphone circuit, and only 32 mV in the AUX input, and the line output level for a "0" recorded signal was 1.2 volts, constant, and not controllable from any panel controls.

The machine is a delight to use, and with the automatic level control—the Comput-O-Matic — one never need worry about overloading a recording. You simply feed in the signal with the automatic control "on," start the recording and "let 'er roll." The first loud note will be reduced in level to the correct "0" and the recording will continue with that setting of the automatic level control until a louder note comes along and then the control brings that one to the "0" again, and so on. To restore the control to the maximum sensitivity position again, simply press the button to OFF, remove the input, and depress the button again to ON. The control then returns to the maximum position.

You can make sound-on-sound recording on the 420XD, adding a new source to one already recorded on track 1 and recording the two together on track 3. And you can do it again back to track 1, if you like, and so on as often as you wish.

You can also add an echo effect by recording on the second track that which you have already recorded on the first, then playing back in stereo. This gives the advantage of being able to control the echo effect better than if both signals were recorded on the same track, but it does necessitate that it be done with mono signals, and the effect is available only when the two tracks are played back simultaneously—that is, in stereo. Not the least of its advantages is the ability to mix a high-level (line) source with another signal introduced at the microphone jacks. Not all machines will permit mixing, but the 420XD does, and this is one of its many advantages. It is not an inexpensive machine, but it does incorporate practically everything a recordist needs for serious work.

Check No. 48 on Readers Service Card

Dynaco Stereo 80 Basic Stereo Amplifier Kit

MANUFACTURER'S SPECIFICATION

Frequency Response: 10 Hz to 50 kHz ±0.5 dB. **Power Bandwidth (IHF):** 8 Hz to 50 kHz half power output at less than 0.5% total harmonic distortion into an 8-ohm load. **Harmonic Distortion:** Less than 0.5% at any power level up to 40 watts per channel into 8 ohms at any frequency between 20 and 20 kHz. Distortion decreases at lower power levels. **Intermodulation Distortion:** Less than 0.1% at any power level up to 40 watts per channel into 8 ohms with any combination of test frequencies. **Noise:** 90 dB below rated output. **Damping Factor:** Greater than 40 from 20 Hz to 20 kHz. **Separation:** More than 60 dB from 20 Hz to 10 kHz. **Input:** 100k-ohms; 1.3 V for 40 watts output. **Dimensions:** 14" D x 8" W x 4" H. **Weight:** 13 lbs. **Price:** $119.95 (kit); $159.95 (wired).

Neat, compact, and effective, are three words that come to mind when one considers the Dynaco Stereo 80 basic amplifier, available either as a kit or factory-wired, as desired. For the difference in price of $40.00, most audio buffs would prefer to build the kit, since it can be completed easily in less than six hours, largely because the printed-circuit amplifiers are already assembled and tested.

There is relatively little difference in the amplifier circuits of the Stereo 80 and the earlier Stereo 120. Circuit configuration is the same, the output transistors are the same, and the performance—allowing for the difference in maximum power output—is the same. The main difference between the two is that the Stereo 120 uses a regulated power supply so that the supply voltage remains constant over the entire range from no-signal to full-power output, whereas the supply voltage in the Stereo 80 drops as the output power increases. In fact, the manufacturer claims that "if they used an external power supply to maintain constant power-supply voltages, they could rate the Stereo 80 at the same power as the Stereo 120."

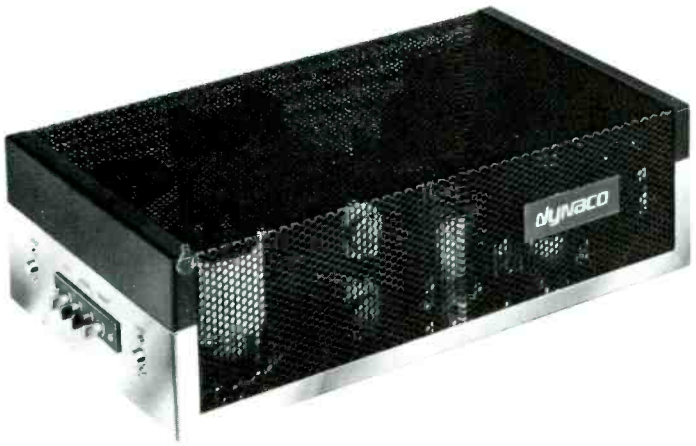


Fig. 1—Dynaco Stereo 80 Power Amplifier Kit.

Circuit Description

The input is fed through a coupling capacitor to a direct-coupled pair of transistors with d.c. feedback from the emitter of the second to the base of the first, providing both stability and linearity. This section drives a complementary-symmetry pair to provide the necessary phase inversion to drive the output transistors in the conventional single-ended push-pull configuration. The complete amplifier except for the output transistors is mounted on a single printed-circuit board for each channel, with the out-

"... the Dynaco PAT-4 is unsurpassed ... a remarkable unit and unmatched at anywhere near its low price ..."

(Stereo Review, January 1968)

DYNACO
PAT-4
$89.95 kit
$129.95 assembled

A separate preamplifier can offer superior performance and greater flexibility than available on any integrated control amplifier or receiver. How well did Dynaco succeed with its PAT-4? Here's what two of the most respected publications say.

The Stereophile, Vol. 2, No. 9, 1968

"With all of its tone controls and filters set to Flat, and feeding any high-level input, we were simply unable to tell whether we were listening to the original 'raw' signal or the output from the PAT-4. In this respect, we cannot see how any preamp, present or future, could surpass the PAT-4."

Julian Hirsch in Stereo Review, January, 1968

". . . (the PAT-4 has) an extraordinary degree of operating flexibility . . . (and) in sonic quality, we would unhesitatingly say that the Dynaco PAT-4 is unsurpassed by any preamplifier we have seen. It is a remarkable unit and unmatched at anywhere near its low price of $89.95 in kit form or $129.95 factory-wired."

The Dynaco PAT-4 preamplifier can be used with any power amplifier, tube or transistor, like the Stereo 120 (60 watts rms per channel) or new Stereo 80 (40 watts rms per channel). Owners of Stereo 70's can also derive the full measure of enjoyment from the PAT-4.

Send for literature or pick some up at your dealer where you can see and hear Dynaco equipment

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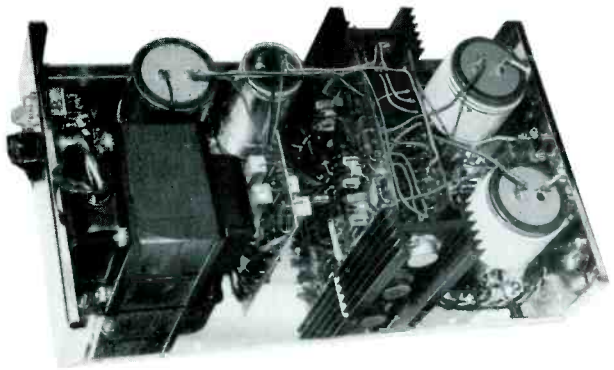

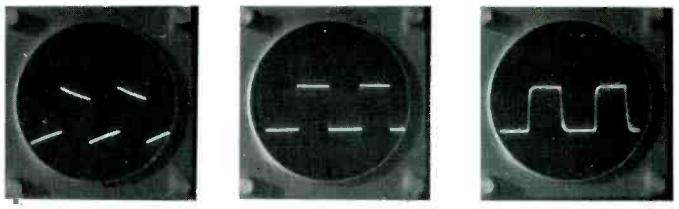

Fig. 2 (above)—Square-wave response of Stereo 80 at 100, 1000, and 18,000 Hz.

Fig. 3 (left)—Interior of Stereo 80 shows neat construction which is easily completed by the kit-builder in about six hours.

put transistors located on a heat sink for each channel. The heat sinks are on opposite sides of the chassis, with the transistor tops facing outward, and grooves in the heat sinks serve to hold the printed-circuit boards in place, resulting in a minimum of work in assembly.

The power supply components—except for the transformer itself—are mounted on a small printed-circuit board which is attached to the "chassis" between the transformer and the amplifier area. The chassis consists of the bottom plate with the ends bent up to serve for the connections, power switch, and fuse, and with a narrow flange bent up along the sides to restrain the perforated metal cover. The chassis/base is chrome plated, and the metal cover is finished in satin black—in all, a net and attractive package.

Coupling to the loudspeaker loads is through 5000-μF capacitors and an r.f. choke which is wound of 16-ga. wire around the capacitors. The chokes measured approximately 3 microhenries in inductance, a value which is commonly used in transistor amplifiers to roll off response in the region above 500 kHz so as to reduce interference and provide absolute stability.

The output terminals are on a strip on the rear apron of the chassis, and are suitably spaced. Terminals are fitted with neat screws which are shaped for easy turning with the fingers and require no tools to make the connections. The inputs are the usual phono jacks, mounted adjacent to the output terminal strip. On the other end are the fuse holder and the power switch, the latter illuminated when power is on. The power transformer has two tapped primaries so as to permit connecting for 100, 120, 220, or 240 volts. This is an especial advantage for those who may wish to use the unit in areas where the supply voltage differs from the usual 117 available in the U.S., or for those who have consistently low line voltages in their areas.

Performance

In all our measurements, we found that the unit performed in accordance with the specifications. And although the specs do not list power outputs at other than the rated 8 ohms, we did measure this parameter. At the rated 8 ohms, we measured an output of 42 watts with both channels operating and a line voltage of 120 and at a THD of 0.5 per cent. At 1 watt, THD reached a much lower value—approximately 0.25 per cent on one channel, and 0.2 on the other. With a 4-ohm load, we measured a maximum output of 25 watts per channel, both operating, at the rated 0.5 per cent THD, and with a 16-ohm load, the maximum output was 14 watts per channel for the same conditions.

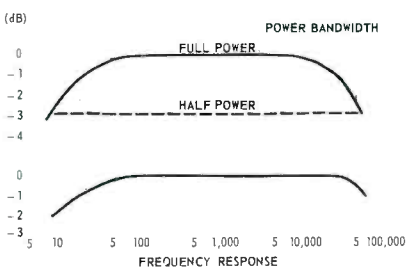

Fig. 4—Curves showing power bandwidth of the Stereo 80, and its frequency response at the 1-watt output level.

Power bandwidth came within specifications—8 Hz to 52 kHz at half power and the same distortion, and separation measured 63 dB with maximum signal on one channel and none on the other. We also measured S/N, and found a figure of 92 dB below rated output. Square-wave response came up to expectations, considering the output coupling capacitor which invariably introduces some slope in the waveforms at the lower frequencies, but as high as 18 kHz, the waveform remained excellent, and indistinguishable from the source. Photos of these responses are shown for 100, 1000, and 18,000 Hz.

The final test of any device in the audio realm is the actual listening, and in this department the Stereo 80 did exceptionally well in comparison with a number of other amplifiers of unquestioned quality. The reproduction had the crispness we have learned to expect from any high-quality solid-state amplifier, and it had the full roundness of tone one likes to hear. Driving the amplifier into admitted overload did generate unpleasant distortion, but the amplifier recovered immediately, and the ears suffered only during the actual overload and not for several seconds afterward. This was more noticeable when observing the output of a 'scope, since one could see the distortion plainly during overload, but immediately the signal was lowered, the waveform came right back to normal. On the whole, the Dynaco Stereo 80 is a rewarding project—one from which you should get some pleasure in building, and one from which you are certain to get a lot of enjoyment from listening.

You pay for what you don't get

Like the inaudible rumble. The result of a motor that runs at approximately 1/6th the speed of conventional motors to reduce intensity of motor vibration. And a belt-driven system that effectively isolates any possible remaining vibration from the turntable platter.

Like the absence of distortion, wow and flutter. The result of a servo-control motor that assures precise speed accuracy and can't be affected by line voltage fluctuation. The electronic servo and the low-speed DC motor reduce total wow and flutter to only 0.08% rms, and rumble to 60dB below the Audible Rumble Loudness Level (ARLL).

Like no troublesome mechanical linkages that can cause drag on the arm and result in distracting sour notes. The remarkable, new Sony Magnetodiode (SMD) initiates movement of the arm electronically, rather than mechanically.

Like nothing added to the recording that isn't on the recording already.

So, you see, you pay for what you don't get. On the other hand, so you don't feel cheated, and don't feel that you are getting nothing for your money—you do get a superb playback system. It includes turntable, precisely balanced tonearm of low mass design that tracks flawlessly, oil finish walnut base and dust cover. You also get the convenience of semi-automatic operation. Automatic shut-off after a record has been played. Automatic shut-off while the record is in play, by simply pushing a button or just returning the arm to rest.

You pay $200 for what you don't get and you enjoy it too. Sony Corporation of America, 47-47 Van Dam Street, Long Island City, New York, 11101

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Fig. 1

Harman Kardon Model 820 Stereo FM Receiver

MANUFACTURER'S SPECIFICATIONS:
TUNER SECTION: IHF Sensitivity: 1.8 μV. **Capture Ratio:** 3.0 dB. **THD** (Mono): 0.5%. **Image Rejection:** Better than 85 dB. **Spurious Response Rejection:** 90 dB. **FM Stereo Separation:** 35 dB.
AMPLIFIER SECTION: Total IHF Music Power: 110 Watts @ 4 ohms. **RMS Power/Channel:** 43 Watts @ 4 ohms. **THD:** 0.5% at rated power. **IM:** Less than 0.5% at rated power. **Power Bandwidth:** 10 to 40,000 Hz. **Frequency Response:** 5 to 60,000 Hz ± 1 dB. **Hum and noise:** 90 dB below full power output. **Tone Control Range:** ± 12 dB Bass and Treble Boost and Cut at 50 and 10,000 Hz. **Damping Factor:** 30:1.
GENERAL: Dimensions: 16⅝" W x 4¹⁵⁄₁₆" H x 12⅞" D. **Price:** $299.95 (includes metal enclosure; walnut enclosure optional, extra).

This newest entry in Harman-Kardon's popular Nocturne range embodies the same serene styling which first attracted listeners to the series some years ago. The entire surface of the front panel is of the blackest black plastic, tastefully framed by polished gold trim with gold and black knobs to match. The upper half of the panel is totally black until power is applied, at which time it becomes softly illuminated in clear green, disclosing the FM tuning scale, a center-of-channel tuning meter and a series of indicator lights which denote signal source and the presence of a stereo FM signal. The lower portion of the panel contains all the necessary controls as well as a stereo headphone jack at the extreme left. A series of "piano key" type switches perform secondary functions, such as tone control "defeat" (for those who would operate the receiver with absolutely flat frequency response), FM muting on/off, high-frequency filter, stereo/mono switch, and loudness (contour). Rotary controls include a speaker selector, bass (ganged for both channels), treble (similarly ganged), balance, volume (including the power on/off switch), function selector switch and, finally, the tuning knob which is coupled to a very effective flywheel. Our only quarrel with this otherwise well-planned control arrangement is the linking of the power on/off switch with the master volume control. Another "piano-key" switch would have served this function better, in our view. A view of the entire front panel of the Eight-Twenty is shown in Fig. 1. Figure 2 shows the back panel layout which, besides the usual input and tape output jacks, features a center-channel output jack, well-spaced terminal screws for speaker connections, speaker fuses, an overall line fuse, FM antenna terminals (300-ohm match only), and an a.c. convenience outlet. A threshold control for adjusting muting is located below the antenna terminals. A switch, adjacent to the second pair of speaker terminals, enables the user to parallel the outputs for use with a single, monophonic speaker system in a secondary location. Incidentally, when the speaker selector switch is set to "Systems 1 & 2", a series fixed resistor of 3.3 ohms is inserted in series with each amplifier output. While this cuts down on total available power to the pairs of speaker loads it prevents the inadvertent application of net loads of less than four ohms. Thus, even if two pairs of 4-ohm impedance speakers are used, the impedance seen by the amplifier channel would still be 4/2+3.3 or, about 5.3 ohms. While most integrated receivers have provision for tape input, (whether it's called "Tape" or "Aux"), the Harman-Kardon Eight Twenty designers have provided *two* sets of inputs for tape, bowing to the new popularity of cassette playback units. The reasoning is probably that many people now own (or will own) both reel-to-reel tape recorders and the more convenient, if

Fig. 2—Rear panel view of the 820 receiver shows neat placement of the input and output connections.

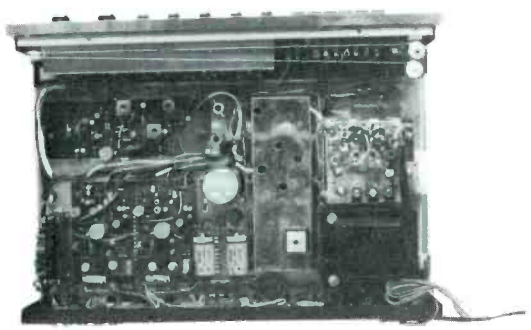

Fig. 3—Internal view of chassis, showing modular printed-circuit construction and sealed front-end and i.f. sections.

The Professionals.

Bill Bell is known as "The Ear." He's the owner of Bell Sound Studios, Hollywood. Bill does commercials, some of the best. You've heard a lot of them. He orchestrates each one, every element of sound from the soft spoken solo voice of Marvin Miller to the high dB blare of acid rock.

Bill's fussy about sound, and so are his engineers. So are the advertising agency production men, the creative people and the account executives. If you're going to take three or more hours to get the right sound in sixty seconds of commercial, you want to make sure the sound is the best possible.

So, as a starter, Bill uses Altec "The Voice of the Theatre"® speaker systems, sixteen of them. And in his custom consoles, Bill Bell also uses Altec audio controls. Again, because he thinks they're the best. After over thirty years of developing sound systems for the broadcast and motion picture industries, that's a nice reputation for Altec to have.

Specifically, each new Third Generation Voice of the Theatre speaker system features a 15″ low frequency speaker that's the finest made. It has a 10½ pound magnet structure, a cast aluminum frame and a 3″ edge-wound voice coil of copper ribbon. All this—plus the efficient new Symbiotik™ diaphragm—provides outstanding bass and transient response, and as much as two times more power handling capability than previous designs. The 18″ massive cast-aluminum sectoral horn has a very wide sound dispersion angle at all frequencies.

The driver. It works from 500 to 22,000 Hz in the A-7-500-8. (The A7 crosses at 500 Hz.) It's so efficient, there's need for only one crossover in the system which eliminates those high frequency peaks and dips. All this means the crispest, cleanest, most undistorted sound you can get from low end through the high.

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lower quality, cassette units. As a side benefit, the dual input availability also means that you can record from reel-to-reel units on to cassette types and vice versa—using just the Eight Twenty as your "master console".

In Fig. 3 we see the top-of-the-chassis layout (with the metal cover removed). Note that the front end *and* i.f. modules are totally shielded. This particular i.f. circuit, by the way, requires no alignment (barring ratio-detector touch-up), since wideband crystal filters are used instead of the usual interstage transformers. Two integrated circuits do most of the amplifying and limiting in this circuit, although eight discrete devices are used as well. The front end employs four active devices, one of which is a Junction Field Effect Transistor, used for r.f. amplification. AFC was not deemed necessary by the designers and we concur, since the front-end frequency stability was very good under voltage and temperature variations likely to be encountered in home use. Frequency calibration, by the way, was also excellent, accurate within about 100 kHz at every point on the dial. Power amplifier circuitry is transformerless and operates in the class B mode.

Measurements

In all fairness to this receiver, we were able to measure IHF sensitivity

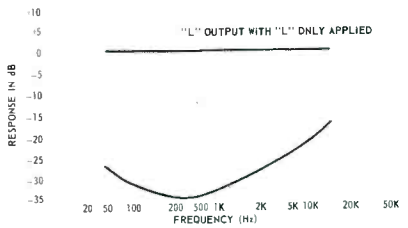

Fig. 5—Stereo FM separation curve.

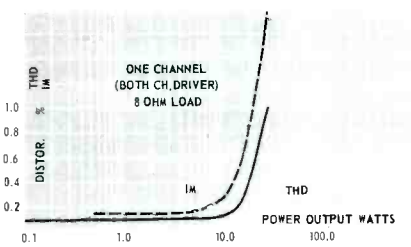

Fig. 6—THD and IM characteristics with both channels driven into 8-ohm loads.

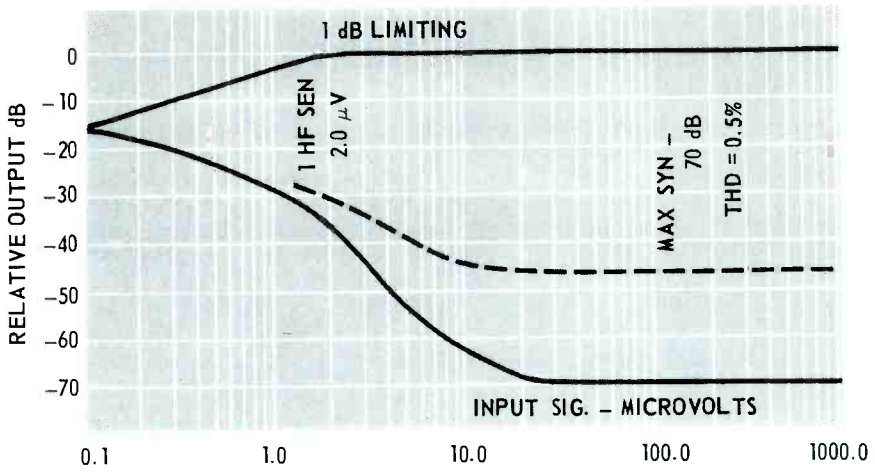

Fig. 4—FM characteristics of the 820 receiver.

at 2.0 μV, rather than the 1.8 μV claimed. However, our measurements were taken at 98 MHz, as prescribed by IHF. It should be noted that at 106 MHz, IHF sensitivity was a bit better than claimed, measuring 1.6 μV, while at 88 MHz, the figure was 2.3 μV. These minor variations could, no doubt, be balanced out by more careful alignment, but all three figures are well within production tolerances. This specification, as well as other primary FM performance criteria, is graphically illustrated in Fig. 4. We wonder why published specifications did not include maximum FM S/N, since the measured value was an excellent 70 dB! 1 dB limiting took place at an input signal of only 2 μV while total harmonic distortion measured 0.5%, as claimed. In stereo, however, this THD figure rose to 0.8%, still a highly acceptable figure.

Stereo FM separation is plotted in Fig. 5 and meets published specifications at mid-band. At the high end, separation drops to about 20 dB at 10 kHz, while the low end maintains a 30 dB separation capability all the way down to about 80 Hz.

We were sorry to see Harman-Kardon join the "±1 dB" power rating which has been editorially decried by this and other publications. Playing this numbers game, H-K comes up with a power rating (total) of 140 watts, although they do publish a 11-watt IHF rating, albeit at 4-ohm load impedance. The r.m.s. per channel power rating of 43 watts was taken from a product-listing in the September 1969 issue of AUDIO, as supplied by the manufacturer and is also based upon a 4-ohm load. In keeping with our usual practice, all measurements were made at 8 ohms, and the THD and IM characteristics obtained are plotted in Fig. 6. On this basis, 1% THD was evident with a power output of 30 watts per channel, with both channels driven. This is a perfectly acceptable power rating for a receiver in this price class, but is a far cry from the meaningless "140 watts ±1 dB" which this manufacturer claims it must publish because "competitors started it."

Power bandwidth extends from 15 to 40,000 Hz, based upon a 30-watt-per-channel (r.m.s.) power rating, as can be seen in Fig. 7. Tone-control range, high-filter characteristic and loudness-contour action are all plotted in Fig. 8, while square-wave response at 100 Hz and 10,000 Hz is pictured in Fig. 9. The photos were taken with the tone controls defeated, since they did have a degrading influence on the square wave or transient response when observed on the oscilloscope.

Listening Tests

If one had to rate the tuner and

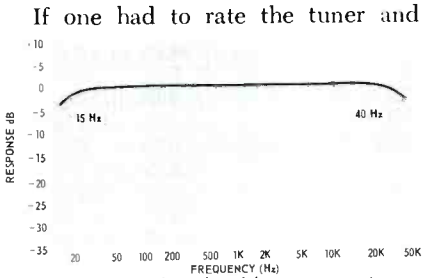

Fig. 7—Power-bandwidth curves. Insets show square-wave performance at 100 and 10,000 Hz.

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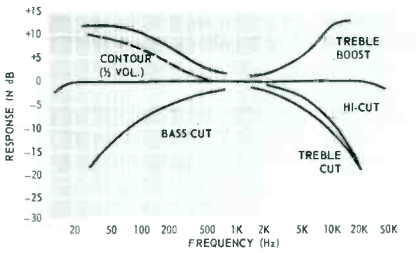

Fig. 8—Tone-control range, filter response, and loudness-contour characteristics of the 820 receiver.

amplifier sections of the Harman-Kardon Eight Twenty separately, the tuner section would come out ahead. Just about as sensitive as any FM tuner we have tested, some 46 stations were received acceptably in our admittedly good listening location. Sixteen of these were received in stereo. Muting was excellent. When set to maximum mute (by means of the rear control), signals having a strength greater than 10 microvolts were able to overcome the mute, and the transition from mute to "no-mute" was not accompanied by any increase in distortion. The station was either "all there" or "not there at all," as it should be. The center-of-channel tuning meter was accurate in all cases, indicating perfect detector alignment. While the stereo indicating light had a tendency to be a bit dim when we were tuned to weaker stations, this did not affect reception or stereo separation perceptibly. In all, FM reception and stereo FM reception ranked with the best of present-day receivers.

As for the amplifier, it has sufficient reserve power to drive *any* low efficiency pair of speakers, but if you plan to use *two* pairs of speakers in two locations simultaneously, they should be of the medium or high efficiency variety. The high-cut filter is of minimal slope and hence not any more useful than the ordinary tone controls. Transients were well defined, more so when the tone controls were out of the circuit. Controls are easy to use and certainly, visually, this receiver fits in very well with our decor. For that matter, its styling is so elegant, that it would fit in well with almost anyone's furnishings. By eliminating AM from this receiver, Harmon-Kardon was obviously intent upon producing as much receiver as possible for under $300.00. In this they have succeeded.

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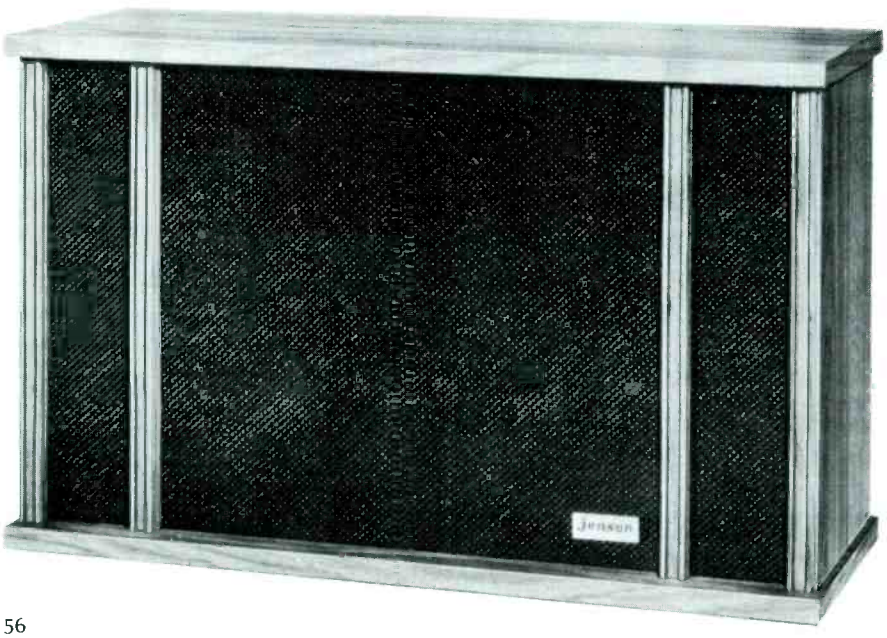
Jensen TF-25 High Fidelity Bookshelf Speaker System

Manufacturer's Specifications:

Input Impedance: 8 ohms. **Power Rating:** 25 Watts. **Frequency Range:** 25 to 19,000 Hz. **Crossover Frequency:** 3000 Hz. **Controls:** High-Frequency Balance. **Nominal Woofer Size:** 10 inch. **Dimensions:** 14" h x 22½" w x 8⅝" d. Suggested Retail Price: **$89.50.**

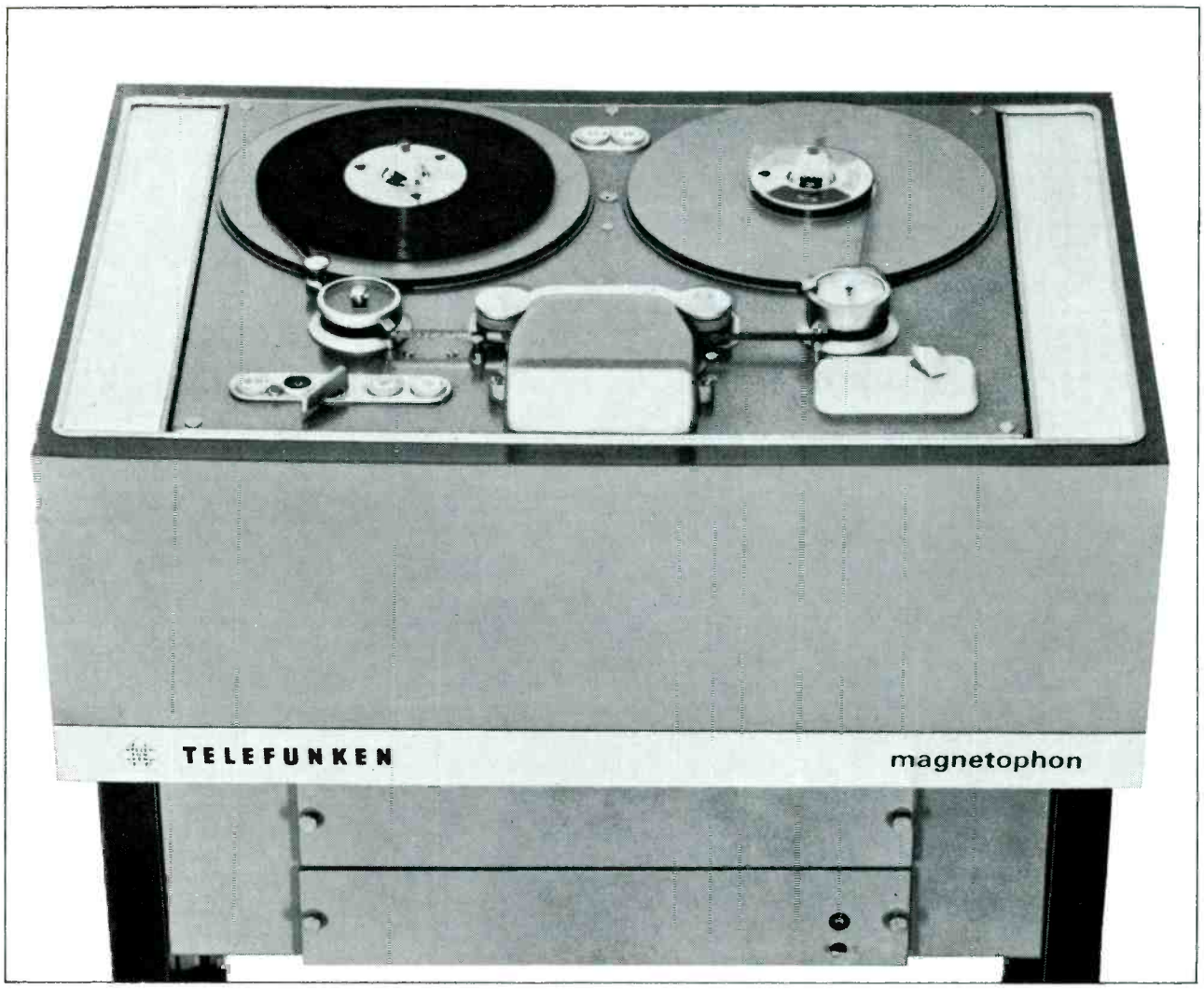
An attractively styled two-way bookshelf speaker system in the modest-price category, the Jensen TF-25 could well be the answer for those seeking a reasonably good-sounding "second system" or for others who require moderately high efficiency in a small enclosure. We were surprised to find that about five watts of clean amplifier power was all we needed in a medium-sized listening area to recreate desired dynamic sound levels. By way of explanation, it should be noted that the enclosure design lies mid-way between the popular, low-efficiency "air suspension" designs and the older, more conventional sealed enclosure more commonly referred to as an "infinite baffle."

The woofer element of this two-way design comes from the "Flexair"® series of loudspeakers which Jensen makes available separately as their C10-PF loudspeaker mechanism. While these speaker elements have a fairly long "throw" or excursion and a soft rim suspension, they should not be thought of as true air-suspension or soft-suspension types. It is this "in-between" design, however, that accounts for the higher efficiency and surprisingly good bass response within the confines of an enclosure that might ordinarily be thought of as suitable for "air suspension" speaker elements only.



The 10-in. element is used all the way up to 3000 Hz, the crossover frequency, at which point a capacitive-inductive crossover network, associated with a wirewound level control, routes the signal to the horn-loaded, compression-driver tweeter. The open end of the horn measures two inches by five inches.

Enclosure construction is solid, with sides and top and bottom made of ¾-in. lumber and the back constructed of ½-in. material. The back is removable by means of ten screws. Attempt is made at sealing the enclosure by means of gasket material placed under the back cover. Styling of the front includes two vertical bars, as can be seen in the photo of Fig. 1. These enclosures may be oriented either vertically or horizontally, although we found that better angular dispersion



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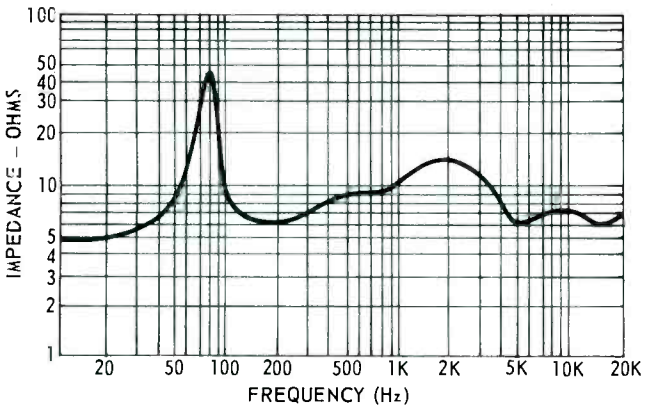
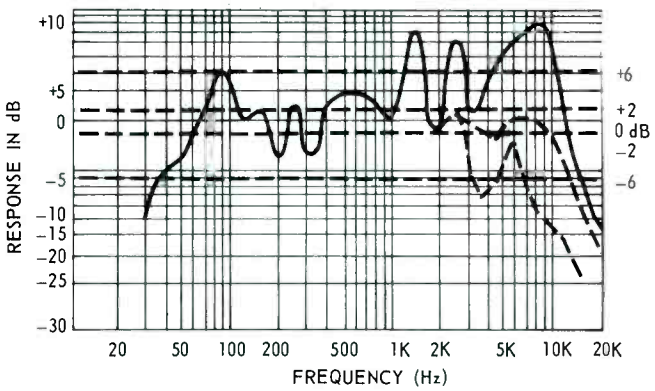




of highs resulted when the enclosures were oriented with the long dimension running vertically.

We performed two types of electrical measurements in connection with the TF-25 units. The first of these involves impedance. Although this system (and many, many others) is said to have a nominal impedance of 8 ohms, it is well known that this figure applies at perhaps one frequency or a specific range in the audio spectrum. In this age of solid-state amplifiers, it becomes very important that a speaker exhibit an impedance characteristic which never falls below the safe limit of 4 ohms, regardless of frequency applied. Figure 2 is a plot of impedance versus frequency. Note, that the nominal impedance of 8 ohms applies at a frequency of 600 Hz. Happily, however, at no frequency did the measured impedance decrease below the safe limit of 4 ohms. This is particularly important at the extreme low end of the spectrum where inaudible but high-powered rumble might damage the associated amplifier if this limit were not maintained. Judging by the high impedance at 80 Hz, we would assume that this is the resonant point of the entire system, despite manufacturer's claim of 25 Hz resonance for the woofer element. It is, by the way, not unusual to have a steep rise in impedance at or about the resonant frequency of the system, as shown in Fig. 2.

The second measurement performed was an open air frequency response plot, using a calibrated microphone mounted on-axis at a distance of three feet from the surface of the loudspeaker system. A word is in order in connection with this frequency-response plot, which is shown in Fig. 3. Most speaker systems exhibit small rises and dips over their entire usable range. In conventional graphic recorder plots of speaker response curves, there are many more dips and rises than are shown in Fig. 3. To present a more meaningful plot, however, we have averaged out the smaller dips and rises, since from an auditory point of view they are relatively unimportant. We *have* included such variations from "flat" response that represent more than a tenth of an octave in spectral width, since these are believed to contribute to the overall coloration of the particular speaker system. Three runs were made at the high-frequency end of the spectrum, corresponding to various settings of the high-frequency balance control. Later listening tests confirmed that the most "balanced" and pleasing sound occurred with this control set to its mid-point.

After testing so many "low-efficiency" systems, the most startling thing about the Jensen TF-25 is its loudness level when fed with just a little bit of power. The control on our receiver, which normally needs to be set at about 2 o'clock for low-efficiency speakers, was set at about 10 o'clock for the same loud level at which we usually do our subjective listening. Highs were quite clean and well defined, as was the upper mid-range sound. The system seemed a bit deficient in the lower mid-range, through this may well have been caused by a pronounced peak at about 100 Hz, which tended to give the spoken voice just a bit of a "barrel" or hollow sounding effect. Admittedly, many listeners prefer this kind of sound, and that is probably why Jensen tailored the response of this system to meet that preference. We find the effect a bit unnatural. One thing is certain, however. Before this system could possibly be overloaded by excessive power, you would long since have achieved more than enough loudness for any listening you might want to do—even in relatively large listening areas.

Check No. 58 on Readers Service Card

Pioneer Model SE-50 Stereo Headphones

MANUFACTURER'S SPECIFICATIONS: **Frequency Response:** 20-20,000 Hz. **Matching Impedance:** 4-16 ohms. **Max. Allowable Input:** 0.5 W (Each channel). **Earpiece Elements:** 3" cone-type for lows; 1 9/16" horn-type for highs. **Cord:** 36-in. retracted, coiled, extends to 16 feet. **Controls:** two on each earpiece—one for volume and one for highs. **Weight:** 1.35 lbs. (without cord); cord and plug, 3½ oz. **Price:** $49.95.

Stereo headphones have become almost *de rigeur* in any modern hi-fi installation, and for a variety of reasons. Primarily, the *aficionado* is likely to want to listen to music at a higher level than the rest of the household, and there are certainly times when the other members of the household may possibly want to watch and listen to TV, or maybe they just want quiet so they can read, study, or what not. In any case, the stereo headphone allows the wearer to listen without either disturbing others or being disturbed himself.

The Pioneer SE-50 headphones solve the problem effectively, and offer the additional advantage of al-

(continued on page 71)

Sound & Decor Styles

William A. Verno, New Rochelle. Another compact installation with McIntosh amplifiers and tuner. Turntables are Rek-O-kut RS4 and Dual 1019—both with Shure V15 cartridges. Speakers are Bozak B-303A's and the headphones are Koss Pro-4A's.

Leo F. Montague, Rochelle Park, N.J. Shows how a lot of equipment can be housed in a very small space by using shelves and tension poles. On the third shelf are two JBL "Athena" speakers and on the shelf below are two Sony cassette tape recorders (one for business, one for the family). Below them is a RCA Color TV set and a Marantz 18 stereo receiver and hanging on the wall are 2 Koss ESP-6 electrostatic earphones which are connected to a Koss T10 control unit. Under the phones is a ReVox A77 tape recorder and above the deck to the right is a Switchcraft 307 4-channel mixer unit and right next to it is a Nordmende 16-band short-wave receiver. On the lower right shelf is a Miracord 50H turntable with a Shure M91E cartridge and on the floor are four microphones—2 Shure Unispheres and 2 Sony ECM22 FET condenser types. The cabinet under the Marantz holds records and tapes, and more tapes are stored inside the two hassocks. Mr. Montague now wants to know just where he can put a transcription turntable, another tape deck and two more speakers!

Robert Desalvo, New York. Here is an unusual but very practical system. The cabinet is made by A and O Custom Furniture of New York and the idea was to combine the advantages of a studio-type control console with the looks and finish of a fine piece of custom furniture. It is very heavily braced with steel plates plus a slab of solid marble! The turntable on the left is a Fairchild 412 single-speed unit and the arm is a SME with an ADC-1 cartridge. The right hand turntable is a Fairchild 4-speed unit fitted with a modified SME arm and Weathers PS-11K pickup system. The tape recorder is a Magnecord Professional 728 and the tuner is a Marantz 10B. A Marantz model 8 amplifier is used with a model 7 preamp. The speaker system (not shown) is a James B. Lansing "Ranger Paragon."

James Lehman, Kelly Music Store, Texas. James is an organ lover and he was determined to build a system that could faithfully reproduce organ music. Four University 15″ woofers take care of the extreme bass (each side) and they cross over at 150 Hz to a University C15W, then a Cobraflex horn, an Altec 802D and two University H600's for the high frequencies. A Sony electronic cross-over is used and the amplifiers are two McIntosh 240's, a 275 and a C20 preamp. The turntable is a Thorens TB150 with a Shure V15 type II cartridge. Two tapedecks—a Sony 630D and an Ampex 350—complete the installation. The dog is a Great Dane: rated output—probably +100dB)

MAHLER AT LENGTH

EDWARD TATNALL CANBY

The big fat album with Herr Klemperer looking out severely from the cover had been staring me in the face for some time—the music inside this box, it said in no uncertain terms, is Important. And so, resignedly, I got at it, one night. Resignedly because, of course, one does not listen to Mahler symphonies in a few moments. This "Song of the Night," as it is subtitled, the Symphony Number 7, takes a large part of whatever night you may choose to audition it.

Somehow I have never been able to adjust my scale of immensity to that of Mahler, nor Bruckner, nor even Richard Strauss. I have enormous respect for the composers of the Renaissance who managed to say so very much in their tiny two-minute pieces. I am simply bored by all composers who run on and on, for hours, when conciseness could have intervened in the first five minutes. I have never been able to believe that art is taking your time.

The trouble with Mahler is that he *is* concise—on an enormous scale. No use even bothering with him unless for active foreground listening. He did not write, as the British like to say, wallpaper music. He is exasperatingly full of content.

First movement. Complex of First Subjects—they go on for maybe ten minutes; then the Second Subject, another complex of a number of important ideas. On and on, more and more of a vast structure, ever more an emotional tour de force, building up on a vast and heroic scale. Gotta *listen*. Have to be engrossed, carried along, overwhelmed by the Mahler superworld. Or else fight free, get out from under, STOP the endless music! I fought with the composer, thus, all the way through the first movement—this was Mahler I did not know well at all —silently screaming to myself, what about all the *other* records I'm supposed to be listening to, literally hundreds, every one waiting for my comment—and how can this man so totally, hoggishly occupy my whole evening with his blasted first movement which is longer than most Mozart symphonies complete?? At the end of the long, long first LP side I came up for air. I went on to something else.

One movement, Mr. Mahler, is enough, thank you—if you insist on bugging me at such absolutely inordinate length. I have my own life to live, Mr. Mahler; I have work to do and time's flying; we have responsibilities to our readers. . . . Off my turntable!

Half an hour later I quietly put on the second movement.

And an hour or so after that I came to the end. I had played it all. Just had to. So will you if you get past the first side. It's that kind of music. My other records, dozens and dozens, necessarily remained silent. One at a time is still the rule.

Otto Klemperer is the King of Mahler today by sheer survival in the flesh, one of the very last who go back to Mahler's own time at the turn of the century. His Mahler is less fervid, heavier in weight, than that of the late Bruno Walter; it goes on the whole rather slowly and makes no compromises at all with time and your attention span. It is thus not easy on first hearing. But the inner structure and detail work is right, the grand concept is there and the music grows on you without problem. There is nothing lax or over-ripe in this lean, spare old conductor's approach, even if his emotional tension is lower-keyed than in Bruno Walter's dedicated Mahler.

I've always loved Mahler's solo-voice music with orchestra because there, it seems, the exigencies of the human voice singing words led the composer into a more concentrated expression, the song, which can't be a song unless it stops pretty soon. Mahler was no Wagner. His songs *are* songs, the most gorgeous ever made, with their unique orchestral backing.

Das Lied von der Erde is a symphony of songs for two alternating voices, soprano and baritone. Klemperer's own version of this work on Angel records is nothing less than superb in its heavenly lengths. But Fritz Reiner's, reissued in stereo on the Victrola label, is a revelation, too, of a startlingly different sort. It is an orchestral experience, voices or no, like other performances in the great series of stereo recordings he made at Chicago back in the days of the first stereo two-track tapes, before there were stereo discs. (If I am right, most of those recordings were never issued in disc stereo on the regular Red Seal label, though they did appear in mono before the stereo disc arrived.)

Reiner was an extraordinary orchestral disciplinarian and in this respect alone his recording of *Das Lied* is hair raising. But there is more, for Reiner's Mahler, like his Richard Strauss (and Bartok) was of a uniquely taut, disciplined, economical sort, all fleetness and tension, of an incredible leanness. The two singers, Maureen Forrester and Richard Lewis, are not the stars in this Reiner recording; it is the orchestral sound that dazzles. The voices, indeed, blend into the orchestra modestly at stage distance—actually no problem since this is as it should be in such a performance. (The recordings, I recall, were made with a simple two-mike pickup and no accent for the soloists.)

Where Klemperer's Mahler is all weight and impressiveness, Reiner's positively scintillates. A much needed perspective on that all-embracing composer and both conductors come out with honors, in opposite ways. Mahler can take it. The two recordings make a fine pair. And by the way, RCA's stereo recording was superb, back some fifteen years ago. You will not believe its age when you listen.

Mahler: Symphony No. 7 ("Song of the Night"). New Philharmonia Orchestra, Klemperer. **Angel SB-3740 (two discs)** $11.96.

Mahler: Das Lied von der Erde. Maureen Forrester, Richard Lewis; Chicago Symphony, Reiner. **RCA Victrola VICS 1390 stereo $2.98.**

Letters

Center Channel

• Mr. Bert Whyte's timely "Special Report On Four Channel Sound" inspires a few comments:

In reference to center "ghost" or "phantom" channels, he states that ". . . a phantom middle channel simply is nowhere near as realistic as the actual third channel." I heartily agree! Although this type of center fill does indeed reduce (or eliminate) the hole-in-the-middle," it obviously reduces (or eliminates) a stereo dimension which can no longer be heard in recent recordings. This effect, which was evident in some older 2 mike, 2 channel recordings, provided a depth and "behind the speakers" transparency which was startling, but was difficult to maintain. It has been my experience that a true, separate, front-center channel not only fills the "hole," but provides this dimensional effect reliably. In spite of this, the industry, with two more channels at their disposal, choose to ignore "stage-center," and assign the extra channels to the rear. Other members at TEAC Corporation of America and myself, have been experimenting with all conceivable 4 channel geometry, and conclude that the front-center addition should take priority. Mr. Whyte seems to imply a similar attitude in his reflections of his past experiences.

I should like to point out an error in the same article: The TEAC 4 channel-in-line record-play deck (Model 4010SRA), sells for $799.50, not $1,200.00 as reported.

Sincerely,
TEAC CORPORATION OF AMERICA
Arne Berg
Director of Audio Products

• *Highly controversial—but readers' comments would be welcome—Ed.*

Outdoor Speakers

• I am planning to install a stereo system in my Palm Springs, California home and would like to put two speakers in the garden and leave them there for months at a time. Because of the wide range of temperatures on the desert and the possibility of rain, such speakers would have to withstand severe climatic conditions. Would you be able to direct me to a company or companies who would have such a speaker able to withstand these conditions and still give excellent fidelity?

SEYMOUR OPPENHEIMER
Chicago, Ill.

• *Quite a number of companies make good outdoor speakers,—Bozak, JBL, Electro-Voice and Jensen come to mind. The Bozak model 1000 is housed in a hemispherical steel enclosure and costs about $80 while the JBL "Carnival" is contemporary in styling at just over $100. Two other possibles are the Electro-Voice "Musicaster IA" and the Jensen HF-100A—both horn loading units costing around $70. All of these speakers will give very good results and are immune from the effects of the weather—except hurricanes!*

Adding a Bass Speaker

• I would like to add Wharfedale 12 inch bass speakers to my Quad electrostatics. What crossover do I need? Can I use an electronic crossover?

JOHN RUSSELL,
New Canaan, Conn.

• *You will find full details of such a system in the next issue (March)—complete with electronic crossover which is probably more flexible for this purpose than conventional types.*

Acoustic Matrixing

• Has Audio published any articles on stereo speaker matrixing as used by Jensen?

PETER WESTBROOK,
St. Charles, Ill.

• *Yes—as far back as November, 1960. The article was entitled "Acoustic Matrixing, a basis for new loudspeaker developments" and it was written by Norman Crowhurst. Another article appeared in the issue for October 1969 and this one was called "Single Speaker stereo" by C. G. McProud.*

AUDIO MUSIC REVIEW

Classical Record Reviews

EDWARD TATNALL CANBY

Mahler and Strauss

The Philadelphia Orchestra/Eugene Ormandy in their FIRST RECORDING of the Mahler Symphony No. 1 with the long-lost original second movement, "Blumine."
RCA LSC 3107 stereo $5.98.

Well, it's THEIR first recording, but not *the* first; that honor went to the New Haven Symphony under Frank Brieff, on a rival label, namely Odyssey. The surviving manuscript with all five original movements turned up in 1959 and was presented to Yale University. After the initial New Haven performance the extra movement, which Mahler had cut out in a revision, was thrown open, so to speak, to the general public, and hence in due time the present recording, which will surely not be the last.

A nicely songful little movement (little, that is, for Mahler) and a pleasing addition to the familiar youthful symphony, now that the original reason for its removal no longer makes much sense: Mahler wanted to get away from program connotations and convert his No. 1 into a rigorously "classical" four-movement work. We discover, at this late date, that a number of ideas long familiar in the body of the Symphony as we have known it actually are related to this movement, which is thus an integral part of the whole structure and should be restored.

Typical Philadelphia performance. Nothing to criticize, plenty to praise, but nevertheless somehow not full voltage. Too slick. (Nobody's against slickness and polish, given real conviction.)

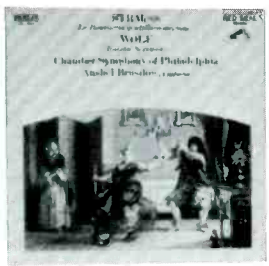
Performance: B– Sound: B.

R. Strauss: Le Bourgeois Gentilhomme—Suite. Wolf: Italian Serenade. Chamber Symphony of Philadelphia, Brusilow.
RCA LSC 3087 stereo $5.98.

Curious how many composers in the early years of this century wrote pseudo-Baroque music, "evoking" the days of Bach, or Purcell, or the age of Louis XIV. Ravel, Reger, Respighi, for instance, to name merely a few Rs. Richard Strauss, too, in 1912.

All of the pseudo-Baroque evocating, in terms of suites of ancient dances and the like, now sounds to our ears decidedly false in any literal sense; we know so much of the earlier music itself. But as the characteristic work of each composer, the music has its own value. So it is with this incidental music to Moliere's famed play about the bourgeois who tried to turn gentleman. It's lousy Louis XIV and about as French as Wienerschnitzel but it makes interesting Strauss, especially when the composer quotes himself, out of his most famous earlier pieces. The music was originally composed for a vast combination entertainment evening involving both the original Moliere play, with incidental music, and an entire one-act opera that Strauss tacked on at the end—Ariadne. Common sense prevailed and the two were mercifully cut apart, the incidental music converted into the present Suite.

The Chamber Symphony of Philadelphia would seem to be one of those spin-off smaller groups that surround a great orchestra such as the Philadelphia—or the Boston—and normally go along as prerequisites of the main recording contract. The orchestra is hardly chamber-size here and the sound is plenty big. Under Anshel Brusilow the Strauss is lively and as humorous as the somewhat heavy-handed approach of the composer al-



lows—this, apparently, was his idea of great musical fun. Lots of good faked-up Baroque tunes (with very un-Baroque instrumentation) including Minuets and a Courante, and plenty of Strauss instrumental color, nicely close-up and very virtuoso. Good piece, well played.

Poor Hugo Wolf! His one little instrumental piece (among so many superb songs for voice and piano) always gets tacked onto the end of something huge. Last time I reviewed it, he had Bruckner for a running mate. Now it's Strauss. Somehow, via thick playing and a vast room sound, they manage to make Hugo sound like Strauss himself here, or almost. Not very good. The piece is gossamer-light, and cannot exist otherwise, even in the orchestral version. Here, it's all blurred and soggy, as though maybe sight-reading were employed. They should have done Salome's Dance in-

stead. Leave poor Hugo for a better moment.

Performance: B *Sound: B*

R. Strauss: Till Eulenspiegel. Don Juan. Death and Transfiguration. Vienna Philharmonic, Furtwangler.
Seraphim 60094 mono $2.49.

R. Strauss: Die Frau ohne Schatten—Suite. Till Eulenspiegel. Solome's Dance. Philharmonia Orchestra, Leinsdorf.
Seraphim S-60097 stereo $2.49.

The old and the new on Seraphim, and they aren't as different as you might expect, the fi aside.

The great Furtwangler, who died in 1954, has a somewhat depressing effect upon me in this late Strauss recording, made just prior to the age of stereo. Somehow the otherwise excellent performances, being rather dull in the fi, bring back all those endless *Till Eulenspiegels* and *Don Juans* that were standard items in a thousand music appreciation course during Fürtwangler's heyday, the pre-war years. Not to mention the sound of the old or prehistoric Deaths and Transfigurations—before hi fi came along—which also graced every beginners' musical menu as a matter of course. If you are unbothered by the old-type sound and the old-type connotations of these three "standards," you will find them the best of their kind, if not exactly super-hifi.

Leinsdorf's most recent stereo versions of *Till* and of the slithery dance of Salome show what marvelous things hi fi and stereo have done between them for Strauss's extraordinary orchestral sonics, so sadly reduced in older recording days. Leinsdorf being somewhat of a Strauss specialist, and the Philharmonia being an orchestra of virtuoso calibre, these versions easily stand up to Fürtwanger and, indeed, may seem even fresher and finer—they did to me.

As for Leinsdorf Side 2, the longish Leinsdorf-made Suite from the World War I opera about a woman without a shadow shows that monster work (4½ hours) to be surprisingly of a piece with early-middle Strauss, and quite unlike the more temperate and subtle music of the long string of later operas. Indeed, you will fancy you hear Till Eulenspiegel himself, not to mention the Don, quite a number of times here, though the effect was surely not intentional. I found it all pretty icky and too much of a muchness and couldn't finish.

Sound: B, C—

That Man Bach

Bach Takes a Trip. Pierre Gossez Jazz. Quintet.
Vanguard Cardinal VCS 10061 stereo $3.98.

A New Sound from the Japanese Bach Scene.
RCA Victrola VICS 1458 stereo $2.98.

The bandwagon phenomenon is positively frightening these days. Just make a success, a real success, of something commercial—and as soon as the necessary tooling up can be accomplished there's a deluge upon the market, of more of the same. Nobody, of course, is directly admitting that the enormous success of Columbia's "Switched-On Bach" has anything to do with the above recent productions, which no doubt occurred with total spontaneity in France and Japan, respectively. I assume nevertheless, that there is at least a tenuous connection and a slightly less than tenuous hope to cash in, while the cashing's good.

Bach's trip into jazz is prefaced by

the statement, easily made under the circumstances, that "Old Johann Sebastian Bach would have loved jazz, which is why good jazz players love Bach." Maybe true. This particular record is not Bach, however. It is simply jazz of a reasonably modern sort, with a certain awareness in its sound of some of the more familiar musical patterns found in Bach's music, though not the structural organization which, in Bach himself, goes with those patterns. None of the jazz is actually based on specific Bach pieces. (No one said it had to—just don't get the title wrong.) The titles aren't exactly Bach either, some of them: Diamant, Maree, Mistral, Sept Heures Trente . . . The stuff is strictly chamber jazz —there's alto sax, piano, harpsichord and drums plus string bass. Totally non-electric and totally non-pop.

Just for that I sort of liked it. Conservative. So much jazz today is falling straight into pop, unable to help itself.

The Japanese "new sound" made me wince and wince again. Real weird. Take a couple of kotos and a

shakuhachi (Japanese instruments), manned by a couple of Sawai and a Yamamoto (people names, those); add guitar, string bass (Takamoto) and Western-type percussion (Inomata), and play Bach on the ensemble—or play Bach with additions and subtractions according to local inspiration. Name-Bach, at that. Air on the G String. Minuet in G. Little Fugue in G Minor.

Two aspects made me wince. First, the Bach melodies are so dismally unsuited to the Japanese instruments and come out so painfully, stiffly, out of tune, that I found them mainly embarassing. They sound so wonderful in their own music! Second and worse, the gentlemen of the back-up ensemble have taken on their improvising job with great seriousness and a hideous lack of Bach "ear." The solid original Bach harmonies are thus melded into an amateurish mush of vaguely pop guitar and bass harmony, neither Japanese nor anything else. I defy any Western ear to make sense of it in any idiom—pop, Bach, or other. Bach's own harmonies are lost in the mush.

Add these to "The Moog Strikes Bach". . . and you have a trio of incredibilities that represent, no doubt, a good many more that I have managed to miss. I still like "Switched-On Bach" best of all. That one will wear on when the others are dead and gone.

Performance: B− B−

Anthony Newman Plays J. S. Bach. (Organ and pedal harpsichord).

Columbia MS 7309 stereo $5.98.

The music critics' comments on this young keyboard artist's concert performance are so right. This, definitely, is not just one more fast-fingered young man. He is a lot more. And a lot of it is challenging and, I suppose, controversial. Some listeners are going to hate his guts. I'd say that at this point his ideas on Bach flow so fast and furiously that even a prodigeous technique can't keep up with them. The man is a helter-skelter genius, like one of those people who can't get the words out of their mouth fast enough to say what they want to say.

No, it is not mere sloppiness. Nor any lack of finger expertise. Or even that common fault, blindness towards musical phrasing and shaping. It's as I say, talent spilling over electrically, going into oscillation in sheer excitement. A very original mind, this one.

Newman divides up his organ works (they are all that) between the pedal harpsichord, which was Bach's own practice instrument for the organ (didn't need a human blower to pump air and it could be played in the home living room) and, in this recording, a pipe organ, a new Baroque-type instrument in a New York church. Typically, he even plays half of one piece on the harpsichord and the other half, the fugue, on the organ. What is unusual is the choice of the pedal harpsichord for most of the big performances, the great preludes and fugues, the celebrated C Minor Passacaglia and Fugue; whereas the organ takes over for some of the less imposing Bach. Interesting, and challenging too.

What makes this Newman Bach new and startling is its mod intensity; it has all the drive of rock and roll and for precisely the same reason. This is Bach for real, Bach lived out in terms of our day, Bach in the youth world. For better or worse according to your taste.

Not only intensity. There's a revolutionary readiness to challenge any normal performing tradition of the moment, right down the line and in a split second at that. Ornaments, for instance. Newman doesn't just add

ornaments. He throws in handfuls, whole passages of artfully arpeggiated chords, melodic lines trilled and turned into whole new melodies. Fine! This is doubtless the way Bach did it, more or less, and with equivalent bravado out of a similar total confidence. I didn't hear a one that jolted my sensibilities, and I tend to be a bug on wrongly played Baroque ornamentation. Newman has the right idea—he knows how you do it and he can turn it out with the greatest of ease, so why not go to town? He uses about ten times as much alteration of the written notes as the average proper Bach player. Bach probably used fifteen or twenty times as much.

The Newman speeds are often astronomical and the excitement is in proportion. He rightly abhors the principle that the older the music the slower it should go—so do I. He is totally right. But is anything lost? Plenty. Many familiar details in the famous Bach scores simply get rubbed out at the Newman tempi, even

though played accurately. No matter. Too many Bach players bring out the details and never hear the whole. The world is full of Bach players who miss no detail. *Something* is always lost in every Bach performance; for he invariably wrote far more than can be performed all at once. The Newman gain in sheer drive and contemporaneity of sound is easily worth the loss of a few special effects here and there. You can get them, after all, in somebody else's performance.

Finally, Newman's Bach is undeniably rough and even unstable in sound, both on the organ and the harpsichord. That is part of his style and a vast contrast to, say, the exquisitely perfect finger work of a Walter Gieseking, a Dinu Lipatti. The tempestuous for-real approach virtually requires this—it is like the deliberate fuzz and distortion in pop music.

If you want the *in toto* effect in a hurry, try the Passacaglia and Fugue in C Minor first-off (it's pedal harpsichord, not organ) and let it play all the way through to its end without interruption. If that doesn't bowl you over, then go get your money back. You deserve it, with interest.

Performance: A– *Sound: B*

Johann Sebastian Bach: Masses BWV 233-236 (Masses in F, A, G Minor, G). Soloists, Gachinger Kantori, Chorus of the Gedachtniskirche, Bach-Collegium, Stuttgart, Rilling.
Nonesuch HC 73020 stereo $9.94.

For those who love the sound of massed Bach (to use the word in both senses) here is an album to keep the ears full for weeks and weeks. There's no sign of *the* Bach Mass here, the famed Mass in B Minor. There are subsequently assembled shorter Masses, each about a half hour long, ingeniously fabricated out of all sorts of earlier Bach works, mainly movements out of the cantatas. This was no less than standard Bach practice and does not in the least denigrate these splendid medium-sized works, which in fact contain much absolutely superb music, largely improved (as usual) over the original models. The B Minor Mass, in case you didn't know, is also in part revamped from earlier works.

There are no less than three recordings of these works now available, counting this one, and two of them in stereo. The Nonesuch album, out of Stuttgart, combines rather ample forces—three different choral groups and nine solo voices—in an impressive ensemble, somewhat old fashioned in its large, rather blurred sound even though instrumentation seems to be technically correct. The singers have that earnest sound of the German choral expert, neither brassily professional nor, at the opposite extreme, thin and amateurish (like so many of our own large choruses). A bit soft, with some quaver and—in the large ensemble—inaudible as to diction. The orchestra is smooth and competent, the soloists, at a properly modest distance and not too loud, are of that generally excellent sort that seem to abound in every German city. An over-all blandness of style and considerable unity. Nobody stands out like a sore thumb.

Like the B Minor Mass, these Masses contain more large choruses than movements for solo voice. (The cantatas emphasize the solo movements, with choral segments often used as a framework.) The interpretations, both of the choruses and the solo movements, are earnest and, alas, on the edge of plodding dullness. Somehow Herr Rilling does not seem to inspire a beauty of line nor a massing of effect, though his performers sing gracefully enough. (Better, perhaps, a few tenor squawks and soprano bleats in the name of enthusiasm than this creamy monotony?) Some of the blame is Bach's, for he is not noted for compromise when it comes to matters of length and complexity of structure. Herr Rilling and Co. may win in the end, though, for a polished performance does get the notes over and the sense will grow in the replaying even without an obvious outward excitement. Still—things could definitely be a lot livelier than they are here.

The recorded sound is somewhat blurred and confused in the large movements—but is it ever otherwise in Bach? No fancy close-up miking; the effect is as of a performance recording, rather bland and flat in the stereo.

Performances: B *Sound: B–*

Schoenberg: Pierrot Lunaire, Op. 21 (1912). Marie Therese Escribano, speaker; Instr. soloists, Friedrich Cerha. **Turnabout TV 34315 stereo** $2.98.

For many listeners of an older age, Schoenberg's "Pierrot" is among the most listenable of his many works, in spite of its (once-modern) dissonance and its curious half-sung, half-spoken *Sprechstimme*, written for voice on a musical staff with rhythms and an approximation of pitch, rising and falling, but no exact notes. There are many reasons for this, among the most likely the fact that this piece has a French lightness (it is based on a French original text, translated into German) and, particularly, a French briefness, in its many short and colorful movements, that contrasts with the out-and-out heaviness of so much Germanic Schoenberg. Also, of course, there is the logical sense of the once-zany speaking voice, half singing, a forerunner of much that is ultra-familiar in today's electronic and "live" music. Finally, there is a certain elegant sparseness to this work, probably a result of the surrealism of the poem, that late variety which in art for us suggests early Picasso, and the whole movement towards fantastic, surrealistic expression that culminated in many famous works (notably in painting and ballet) in the WWI period.

The lady who half-sings, half recites the brief poems is surrounded by a half-dozen-plus soloists on instruments, from piano to bass clarinet, mostly used only a few at a time for maximum color and mood contrast. The music is atonal but not twelve-tonal, if you see what I mean. Wholly out of the earlier super-Romantic Schoenberg vein. Not yet into the serial.

In recording, as in the flesh, "Pierrot" depends very much on the lady who takes on the demanding speaker-like role. Mostly, earlier recordings have (rightly, I think) featured big, prepossessing females of an imposing sort, whose voices could carry both the volume and the wide pitch range of the exaggerated speech-song. I heard Schoenberg conduct the piece in person, before WWII, in the old New Friends of Music concert series in New York. He used a lady powerhouse named, if I remember rightly, Erika Stiedry Wagner, and she was all that the name implies, an imposing female, big contralto type, who could blossom into impressive soprano tones at the climaxes. She made your flesh crawl! (Mine, anyhow. Flocks of staid conservatives rudely walked out on Schoenberg right in the middle. I was really shocked.) Her version was recorded but is no longer available.

So much for perspective. In this new stereo version the lady speaker is curiously un-massive and un-Germanic (note the name). And she is curiously placed in the recorded perspective. First, she is more of a light soprano speaker, with a far less imposing presence than would seem to be required for this demanding role. Not enough projection. Her German diction (Schoenberg, remember, was *not* French!) is neutral, where it ought to be, if anything, exaggerated for effect. Moreover, for reasons best known to the recording team, she is placed far off mike, out in the middle of the instrumental ensemble. A leaning-over-backwards? Laudable in some cases but not for this lady. She is far too often drowned out, overridden, by the instrumental sound and very few of her words get through with their all-important impact.

Worst of all, Vox omits the texts! That leaves us high and dry. There is only a summary of each item. You miss the whole significance of the experiment, which was to project *words* and surrealistic *word meanings* in a new kind of half-musical speech. It just doesn't work here. It can, and often has. The instrumentalists, by the way, are excellent.

Performance: B– *Sound:* B–

Glenn Gould The Mozart Piano Sonatas, Vol. 2. (Sonatas Nos. 6, 7, 9). Glenn Gould, piano. **Columbia MS 7274 stereo** $5.98.

As Columbia says, (out of Newsweek), Glenn Gould's every recording is greeted like an epiphany. If that sounds to you like some sort of a tropical fruit, you aren't too far wrong. But Gould, for many reasons, is an important musician, one of those who in spite of himself is a born leader in taste and attitudes. It is Gould who has shocked the piano world by eschewing *all* live performance in favor of recorded. Why not?—some of us would say. Not the pianists! Other pianists show up, perhaps, better on records than in the flesh. Paul Badura-Skoda is one who comes to mind. But that is perforce. With Glenn Gould it is a matter of public choice—which puts a different slant on things. That's the way he is.

As a musician, Gould is an independent and a "loner." But it begins to be apparent now that he was just about the first of a whole new breed of interpreters on piano who are already beginning to constitute a new school of approach—I like to call it neo-Romantic. Peter Serkin is a recent recruit, for example. Glenn Gould's Mozart is, accordingly, a startling experience for all of us who take the established sort of Mozart playing for granted. Phew! Sounds awful when you first try it. Raises very serious questions, though. What *was* Mozart really trying to get at, in these little sonatas, so familiar to every pianist, beginner and advanced alike? Should Mozart now sound like tempered Rachmaninoff? That's what you'll find in Gould and Serkin and friends. If not Rachmaninoff, then at least tempered Schubert. No more eighteenth-century reticence! No more miniaturization, none of that admittedly over-plugged delicacy of touch and phrasing so widely practiced by older pianists in the field. The idea, now, is to show that Mozart Really Meant it. And if that requires loud, passionate playing on the modern grand piano, then at least it is honest playing.

I'm not sure myself that passion requires quite such flamboyant honesty, which maybe makes me very square. I do not mind the *idea* at all of expressing musical feeling in today's terms, however Romantic. But I do miss the subtleties of phrasing and balance between elements of the music that older pianists did achieve, and which seem to me a permanent part of the Mozart music—for any age. One can be respectful of Mozart's message while at the same time being reserved, underplaying for maximum effect.

Or can one? This is no day for understatements! Maybe Glenn Gould is Mozart for the next fifty years. Better try him, this volume and Volume 1 as well (and forthcoming vols.). And watch out for Peter Serkin, to see how the school is spreading.

Performances: ?? *Sound:* B

Edward R. Murrow—A Reporter Remembers. Vol. 2, 1948-1961. Introduction and narratiaon by Charles Collingwood.
Columbia 02L 400 (2 discs) mono ($11.96)

Edward R. Murrow was a born genius of the low-fi microphone, a man who could "get through" both in sense and personality even though on receiving radios his sibilants did not exist and the hiss and static surrounding him often was ruinously loud. He was a superb high-level ham, too, who knew how to dramatize every idea and fact he wanted to get over. In Volume I of his collected broadcasts, those of us who lived through the War were again thrilled with remembrance at his familiar broadcasts from besieged Britain, from a bomber raiding Berlin, and many more. Here the series of excerpts carries on to the end, in 1961, when Pres. Kennedy took him out of broadcasting to head the U.S. Information Service. He died of lung cancer in 1965. All sorts of subjects are here covered, many of them necessarily lesser in importance than the epoch-making stories in Volume 1 but nonetheless interesting in the listening. They range all over the place, from Hurriance Edna in 1954 to Senator McCarthy (the First) a year earlier and the Kennedy inauguration in 1961.

To those who are knowledgeable in audio, perhaps the greatest tragedy in Murrow's audible career was the outrageously poor quality of his broadcast *recordings*, right up to the very end in 1961. We have all deplored the postwar sound of the rival camp, over at RCA-NBC-Victor; did CBS go right on using a 1930-type disc recorder to take down these famous transmissions for their historical impact in later years? If so, CBS was abysmally parsimonious. Not even a four-track portable tape recorder? For a dozen-odd years this travesty of the recording art was allowed to continue. Hard to believe. But, luckily, it has not spoiled the basic value and entertainment of the album. Just makes it harder to listen to. Edward R. Murrow deserved better.

Performance: A *Sound:* D–

Check No. 69 on Reader Service Card

TAPE GUIDE

(from page 16)

Too Much Bass

Q. Not long ago I bought a ° ° ° ° tape recorder and noted a short time afterward that recordings on it are extremely bassy, especially when played back on other recorders. The sound is otherwise excellent. I found out later that this is true of all ° ° ° ° recorders of the same model. Unfortunately I have been unable to find another recorder to suit my purpose, even in higher price brackets. The man at the repair shop said he could make a bass cut if he had a wiring diagram. I wrote the company for one and for instructions for making the correction. Instead of sending what I asked for, they sent me literature on various products I have no use for; no wiring diagram was included. My tape recorder has no tone control, but according to several books a bass cut can be introduced into the microphone circuit. However, they don't mention how it is done. How is such a bass cut made?—John F. Martin, APO San Francisco, Calif.

A. It may be that the bassy characteristic of your tape recorder was deliberately introduced to cover up its otherwise hissy characteristic.

Apparently you wish to introduce bass cut in recording, and in the microphone circuit. If yours is a piezoelectric microphone (crystal or ceramic), this can be done very simply by reducing the load resistance into which the microphone feeds. This is equivalent to placing a resistance across the microphone leads. I cannot tell you exactly what resistance to use. You will have to find this out experimentally. Try something like a 500,000 ohm resistor to start. If bass is still excessive, successively try values such as 250,000 ohms, 120,000 ohms, etc. If yours is not a piezoelectric microphone, you can achieve bass cut by feeding the hot lead of your microphone through a small capacitor. Again the value must be determined experimentally. You might start with a value of about 2,000 or 3,000 pf. If bass is still excessive, use smaller values of capacitance.

That Rattle!

Q. I own a ° ° ° ° tape recorder. In all modes of operation and even when free-spinning, the right reel-spindle makes a continuous rattling or crunching noise. The recorder has been to an authorized service station twice, but the noise is still present. Please, if you can, tell me what my problem is.—Ernie J. Caine, Lee's Summit, Mo.

A. The drive mechanisms of tape machines differ appreciably from one to another, and it is therefore difficult to supply a general answer likely to fit your problem. Is it possible that it is not the reel spindle that is rattling, but the reel itself? These do rattle sometimes. Another possibility is that what you think is the spindle rattling is actually noise produced by a drive belt. In this case, belt replacement is of course in order. The only other suggestion I can make is that you locate another authorized service agency and have better luck than with the first one.

Surface Noise

Q. I have become quite interested in dubbing some of my disc recordings onto tape. My problem is essentially this: Although my discs are as clean as I can get them using the best of commercial dust and static removers, I still get some surface noise. Of course my tape recorder picks these noises up faithfully, along with the music. Perhaps I am a bit too much of a perfectionist, but I would like to eliminate the surface noise from the disc when dubbing it onto tape, without having to edit each pop or click. How can this be done with my existing equipment? The "high filter" on my amplifier only operates on playback and has no effect on recordings made through the "recorder out" outputs. Does any company that you know of make a relatively simple, switchable filter that can be connected between the outputs of my amplifier and the imputs of my tape recorder? —David C. Cumming, Blythe, Georgia.

A. I know of no such filter commercially available that I can suggest to you, although quite some years ago, when 78 rpm records were still with us, some companies did make "dynamic noise suppressors." If you wish, you could consult the early *Audio Anthologies* for articles on such circuits. However, I must warn you that these are quite complex. I doubt that you will find a circuit that is truly effective for the occasional pop or tick you get on today's quality phono discs.

Tape Editing

Q. I have a ° ° ° ° tape recorder hooked up to my receiver for recording and playback. I want to hook up a second tape machine to my system for playback only, to be used for editing. This arrangement works fine if I use the auxiliary outputs for the second machine. However, I want to use the auxiliary outputs for TV sound. There are outputs for a tape deck which I would like to use, but neither tape machine will work in these outputs, nor will the TV sound. Is there any way to utilize the tape head outputs by modifying the tape machine or the TV set? If there is no way to do this, what type or make of tape mechanism could be used in the outputs?—William J. Zinn, Hanover, Ontario, Canada.

A. In referring to "outputs," such as the "auxiliary output," I take it that you really mean the *inputs* of your receiver. One way of handling your problem is to connect the signal directly from the playback heads of your second machine to the tape head inputs of your receiver. Alternatively, you could modify the tape head input so that it will accept a high-level signal, such as that from the playback electronics of your second machine. This involves decreasing the gain of this input and removing tape playback equalization; this can perhaps be most easily done by bypassing the first playback stage. Another possibility is to connect both your tape machines' output cables to the same input of the receiver, using a Y-connector. There is some chance, but less than 100%, that this will work satisfactorily; it depends on how the two machines interact with each other. Still another possibility is to purchase an audio mixer, with the outputs of the second tape machine and the TV set going into the mixer, and with the output of the mixer going into the auxiliary input of the receiver.

Equipment Profile

(from page 58)

Pioneer Model SE-50 Stereo Headphones

lowing the listener to adjust both the level and the balance between highs and lows to suit his taste. Also, the SE-50 makes it possible for two people to listen to two pairs of phones with different listening levels for each, which is a definite advantage.

The phones consist of two plastic housings, white in color, with dark gray plastic "baffles" over which the soft pads are fitted. The pads are covered with a soft kid leather which results in a comfortable feeling of luxury, as well as providing a good acoustic seal against sound from outside reaching the listener's ears, or against sound from the phones reaching the outside.

The headband is also well padded, and at the point where the bail is attached to each phone there is a knob which actuates a potentiometer inside the housing—the one at the front controls the treble level, and the one at the rear controls the overall volume to the phone. Thus the user has complete control over each phone, both as to level and to frequency response. The coiled cord, which measures only 36 in. when retracted, extends to a full 16 feet, giving a longer radius of movement for the user than is usual with headphones. The cord is terminated with the conventional three-conductor plug. Extension cords are available when it is desired to listen further from the system than the cord allows, and a "Y" cord is also obtainable as an accessory when two sets of phones are to be used with equipment fitted with only one phone jack.

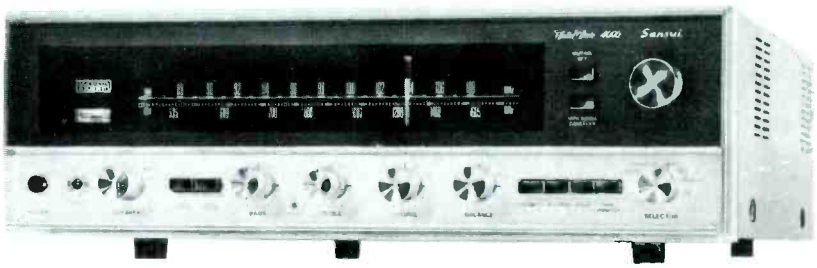
Performance

The SE-50's are fairly sensitive, requiring an input signal of only 0.1 volts for a reasonable listening level. The phones are quite comfortable, even for long listening periods when wearing glasses, which is an important consideration for those who must wear glasses at all times. The adjustments of position are easily made, and spring tension is adequate to ensure good head contact. Sound is smooth down to below 50 Hz, and audible to this observer to well over 12,000 Hz, and measurable to 21,000. The ability to control the balance is definitely a plus feature, and one which the user will enjoy over much listening.

The phones are packed in an attractive box which serves as storage for them when not in use. The box is covered with a dark blue leather-like material which carries out the fine appearance of the phones.

Check No. 70 on Reader Service Card

This is the Sansui 4000 reviewed last month. Our picture showed the 2000 instead. Apologies to Sansui!



menu

Light Listening

by

Sherwood L. Weingarten

For musical gourmets and gourmands, 1969 was *not* a vintage year but there were enough high spots to concoct a pop menu to please the audiophile's palate. Sufficient at least, to keep me from jumping off the nearest clef despite the preponderance of bland offerings.

What follows, be forewarned, are not the best of '69 (according to polls, that is) but a personal selection of favorites. Hors d'oeuvres are served on the proverbial golden platter by an original cast—superb if you don't mind a little British HAIR in your food, or the fact that it's a copy of the American dish of the same name. The Atco recording (SD-7002) which rocks while rolling into the Establishment, slings darts via pungent songs at the hypocrisy of the Big Three no-no's—Sex, Religion, and Politics.

The entire LP is spiced with frenzy (even the ballads seem to carry an urgency with them) and captures what the liner calls "a crystallization of the Revolt of Youth," a characterization of the "lack of communication between the generations" The best number is "Abie Baby" with pro-quality lyrics superimposed on a twee-do, wop, wop vocal arrangement that spoofs the rhythm-and-blues ditties of yesteryear. But don't overlook the chartbusters, "Aquarius," "Good Morning Starshine," and the title tune of the love-rock musical. And beware, however, of overindulgence (wearing out the groove, that is) or you may never get to the entree. And oldsters with teeth unaccustomed to chomping on reality may choke on the obscenities.

A cocktail worth nursing is NANA MOUSKOURI SINGS OVER AND OVER (Fontana, SRF 67594) a treat because of its simplicity in arrangements and a careful attention to lyrical beauty. The Greek songstress with flawless English and phraseology delivers a dozen winners that include Gordon Lightfoot's poetic "Song of a Winter's Night," Ewan MacColl's lovely ballad "The First Time Ever," and Paul Simon's "Scarborough Fair Canticle."

"Try to Remember" contains an echo harmony and mellow guitar ripple, while "The Lily of the West," a composition by Miss Mouskouri, is a soft tune with driving beat painted onto a mixture of English ballad style and Western motif. "Erene," one of two tunes written by guitarist George Petsilas (a member of the background ensemble, the Athenians), is an up-tempo swinger with the flavor of a Greek dance and quasi-jazz stylings.

But it's the brunette's angelic voice that will make the taste buds tingle.

For an everything-but-the-kitchen-sink salad, THE BEST OF EARL GRANT (Decca, DXSB-7204) is delightful. A variety of appetites can be satisfied by the two-disc set with 22 tunes that basically are pseudo-jazz (spell that p-o-p) showcasing the organist-pianist's vocal abilities (if you liked Nat King Cole, you'll enjoy Grant) as well as his keyboard talents.

"Sweet Sixteen Bars" begins slow but builds to an organized crescendo—with Grant grunting a la Errol Garner or Oscar Peterson, but "Saints" in contrast, is a Dixie cup of joy filled with a heavy brass sound and bluesy piano. "Ebb Tide" is a novelty, complete with bird calls produced by high organ notes; "More" offers a Brazilian beat, "A Closer Walk" is a gospel-like entry, and "House of Bamboo" goes calypso while "Stand by Me" goes funky.

The entree, which must be bitten into deeply to be appreciated fully would be a diatribe-speech-comedy album: DICK GREGORY, THE LIGHT SIDE, THE DARK SIDE (Poppy, PYS-6000I), a two-disc package that should rate as the most important recording of the year.

Gregory proffers unvarnished Truth, illusion-shattering blasts at social inequities. With venom the comedian-politician attacks the "white racist institution" he claims America is, but he always underlines his barbs with advocacy of non-violence and a touch of humor. Occasionally he becomes so zealous in his truth telling he stumbles over his words, but the thoughts come through and compels the open-minded listener, white or black, to listen again and again.

Despite an apparent call for direct explosive action, he mainly wants to shock his audience into thought. We must, he indicates, create an atmosphere of trust between races, between nations. "I could go to Vietnam tonight and get killed by the Viet Cong," he says. "This country would give my black wife $10,000, she couldn't take that $10,000 and buy her a house in any area she wanted to buy in. Hell, I got killed shootin' at the wrong folks."

He does not, however, limit his plea to the black plight. "You're busy passing out food stamps in South Carolina to black folks," he intones. "There's some white folks in Appalachia that need some food stamps too. I hope you get concerned with all people."

Gregory cites the assassinations of John and Robert Kennedy and Dr. King. But, he charges, "nobody in America got upset when they assassinated George Lincoln Rockwell and Malcolm X. See America is not a nation that gives a damn about assassinations until you kill somebody we like, and 98 per cent of everybody in America that got upset over Martin Luther King's assassination, they would not be upset in the morning if George Wallace were assassinated. You got to make this a nation that gives a damn about assassination no matter who it is."

To help wash down the entree, a sweet wine in the form of THE WONDER OF YOU (A&M, AP4180) is suggested. The vinyl by the Sandpipers, a singing trio that probably hands down the richest harmony available on record, spotlights middle-of-the-road music par excellence. Never veering too far from the Latin rhythms that complement their gimmick-less sound, three young men (Michael Piano, Richard Shoff, and Jim Brady) present 11 winners. They run a wide gamut from the Academy Award winning "The Windmills of Your Mind" to "Lo Mucho Que Te Quiero" (The More I Want You.) The latter is an example of what they do best, soft creamy polytones in Spanish and then in English. In a day when screeching seems to ring the cash register, their victory in the Softness Sweepstakes is a Joy.

Dessert, an imaginative, rich pastry platter is served by Stan Kenton. Another version of HAIR (Capitol, ST 305), the recording makes full use of 30 musicians and arrangements of Ralph Carmichael in its all-instrumental, big band goodness. There are 10 tracks of jazz-pop interpretations crammed with the best stereo sound ever. Highlights include the thorny, frenzied alto sax of Bud Shank in "Aquarius," the electronic out-of-this-world

weirdness of "Walking in Space," the Coltrane-like riffs by trombone, alto, and baritone sax, and trumpet in "Colored Spade," and the rhythmically wild approach to "Easy to be Hard." You can try a little at a time, or the whole thing at once. The result is a pleasant aftertaste. And if that's too exiting, an after dinner cordial strictly for relaxation is available in the form of DEBUT (RCA Red Seal, LSC-3106) by the Philadelphia Orchestra Pops, a 110-member ensemble that performs works by Henry Mancini under his baton.

The first side includes an "Autobiographical Suite," three segments recalling Mancini's teenage years in Pennsylvania while the flip side contains half a dozen brief interludes that give various sections of the Pops a chance to shine. At this point, all that's left is the possible need for an antacid, or you can always turn to your own favorites or . . .

° ° °

Rock obviously has come a long way, and its experiments show the future is blazing. SAN FRANCISCO ROOTS (Vault, LP-119) portrays the hard rock initiation in San Francisco a half dozen years ago; UNCLE MEAT (Bizarre-Reprise, 2024) shows today's rock intermingled with satire and weird tricks, while TOMMY (Decca, DXSW 7205) is an attempt at a rock opera.

The "Roots" album is a compendium, with Grace Slick & the Great Society leading with one of the biggest of the screamin' successes. "Somebody to Love," a forerunner of the hard rock trend, also is probably the best cut of the LP's 13. The Great Society, after being one of the originators of the Frisco psychedelic sound, was followed by Jefferson Airplane, a group that catapulted the tune, by the grace of Grace, to the top. The Slick shouter also builds up fire on "Free Advice."

The Beau Brummels, one of the few early West Coast groups to really make it, offer a quartet: "Stick Like Glue," "That's If You Want Me To," "Don't Talk to Strangers" and the (seemingly ill-fitting) slow, folky "Sad Little Girl."

Others represented on the LP, basically an insight into youthful tribal dance tempos, include the Mojo Men ("Dance With Me" and "She's My Baby," an early indication of the blues

trend); the Knight Riders ("I"), the Vejtables ("Anything" and "I Still Love You"), and the Tikis, who evolved into Harper's Bizarre ("Darkest Night of the Year" and "Pay Attention to Me").

"It's hard if you're standin' in the shadows of a very famous man." The line is part of a song written as a tribute to his father, and appears on a new MGM album, HANK WILLIAMS, JR. LIVE AT COBO HALL, DETROIT (SE-4644). "Standing in the Shadows" sums up the country singer's feelings, and his voice trembles a bit when he interjects dialogue between the brief choruses. The awe is there, and so, it seems, is a tinge of jealousy; but it's somewhat maudlin, too, leaving the armchair listener squirming uncomfortably.

The live audience, however, apparently loved it (unless the engineers turned up the applause), as it did the other 10 tracks. The entire recording, in fact, is punctuated by cheers, whistles, and applause, insertions that add excitement to the LP.

Junior, chubbier than his late dad, wears his hair longer and dons flashy outfits in an attempt to create a personal image. Despite the drugstore cowboy appearance, though, he realizes his drawing power depends largely on the legend's material. Thus he sings "Jambalaya," a performance that is excessively jerky and fast, with words sometimes muffled; "You Win Again," "I'm So Lonesome I Could Cry," "Your Cheatin' Heart," and "I Saw the Light," all of which retain much of the twangy guitar work and vocal phrasing his father used (although Junior's voice is deeper and more vibrant).

The best numbers, however, are those that are more recent in composition. "Detroit City," for instance, is a particularly good urban blues, with a poignant spoken interlude. "Games People Play" has more bounce than the original Joe South version and, as a bonus, the acrid words are discernible. "Darling, You Know I Wouldn't Lie" features a saloon-type piano sound, heavy beat, and twangy guitar. And "Foggy Mountain Breakdown," extracted from the "Bonnie and Clyde" film, has some great banjo pickin' as it showcases bluegrass at its instrumental best.

And while MGM capitalizes on the name, it also dips periodically into its archives for a new anthology of the original. The latest? THE ESSENTIAL HANK WILLIAMS (SE-4651), with 11 tunes (all Williams originals, except "May You Never Be Alone") stressing the singer's simplicity and fine country voice. Although the sound quality is excellent considering the age of the masters, the stereo effect (engineered, of course) is limited. But the occasional overdubbing does not detract from the tunes' impact, and, more important, the melodies are not over-orchestrated as is the tendency on modern country music.

Best are "Lovesick Blues," a yodeling winner; "Kaw-Liga," a bright, humorous tale of a wooden Indian, with violins added; "Honky Tonkin'," a toetapper that sounds like Grand Ole Opry then and now; "Move It On Over," featuring a vocal combo that echoes Williams' words as the quasi-boogie rhythm builds, and "Long Gone Lonesome Blues," the type of tune again becoming popular (with the added attraction here of a sliding vocal). "I'm So Lonesome I Could Cry" also should be heard, and can be contrasted with Junior's version.

If that's not enough Williams for you, one of 11 cuts on THE BEST OF TIM HARDIN (Verve Forecast, FTS-3078) is "Tribute to Hank Williams." Unfortunately, it's not a good song, either melodically or lyrically ("I didn't know you but I've been places you've been," Hardin intones).

Hardin, a better wordsmith than singer on this outing (the cuts all are taken from his first two LPs, "Tim Hardin 1" and "Tim Hardin 2"), has a husky voice with a narrow range. He *can* be effective, but only when his lyrics allow it.

Tops are "If I Were a Carpenter," a beautiful song with a smooth arrangement (especially the harpsichord sound coupled with jazzy, syncopated drums); "Reason to Believe," a soft folk-rock entry that combines strings, a near-calypso beat and ballad format; "Misty Roses," with its Latin feel; "It'll Never Happen Again," a melancholy success that is really a contemporary art song about a first affair; "Lady Came from Baltimore," a folk idiom winner, and "Smugglin' Man," sort of a protest-rock number (with heavy blues influence) rapping those who sell arms to both sides of a conflict.

The album is good, but not quite as good as the composer-singer's previous one TIM HARDIN 4 (Verve Forecast, FTS-3064). That, with all 11 tracks penned by the artist (except for "House of the Rising Sun"), shows a more mature style, a development that led to his leaning strongly on blues, rock, and the pounding Memphis beat. The disc is aided by good stereo, a flighty harmonica, and music that lends itself to dancing (no waltzes, dad). Witness "Airmobile," "Whiskey, Whiskey," "Seventh Son," "Danville Dame," both parts of the split "Ain't Gonna Do Without," and "Bo Diddley." It's music so youthful, so vigorous it can delay Hardin-ing of the arteries for anyone.

It's sort of a mix-and-match affair, geared to appeal "to everybody" and, as is so often the case, to no one.

The strawberry blonde who found the limelight via a film now capitalizes on it with THE GIRL FROM "OLIVER" (Kapp, KS-3606). Shani Wallis, who has a voice resembling a slightly watered-down Barbra Streisand, is best when she sticks to the tunes she's become associated with—but proves that her range is wide.

The singer, who can be physically compared to a combination of Doris Day and Mitzi Gaynor, offers two from "Oliver" (her musical signature, "As Long As He Needs Me," a schmaltzy but groovy number; and "Where Is Love," a silky-smooth winner). In addition, "How Are Things in Glocca Morra," a standard from "Finian's Rainbow," is given a gala production-number treatment, subdued to a degree despite the brassy background; "The Impossible Dream," from "Man of La Mancha," is sung beautifully (but the track is marred by an overriding "background" sound), and "I'm Just Wild About Harry" is tied in a sexy package by the near-whispering vocal.

Accompaniment most evident consists of strings, strings, strings, and quiet horns not muted but kept from intruding by being away from the mikes. Stereo is particularly good for a vocal disc, and mention must be made of the singer's superb diction. Over-all, the album provides pleasant music that narrowly misses being great.

NEGATIVE FEEDBACK

(Continued from Page 24)

does its job properly and that the drive stage is a perfect amplifier of the characteristic stated earlier (amplification factor 20, plate resistance 7.7K). Effects due to actual drive-stage distortion can then be added afterwards to the consideration of output-stage distortion.

The output-stage non-linearity will vary the factor by which the drive-stage plate load is multiplied, thus varying gain there. Let's use this fact as a basis for calculating the effects of feedback on distortion. The effect in reducing change of gain will be the same as that reducing distortion.

Assume gain rises by 5 per cent, so the grid-to-cathode input for the output stage needs to drop by 5 per cent. At the same time, the effective plate resistor for the drive stage rises by 5 per cent and as a result the drive-stage gain rises from 16 to 16.1.

The output-stage grid voltage needs to drop from 220 peak to 219 peak. So the drive-stage input would need to change from 13.75 to 13.6 to maintain uniform output. Vice versa, this represents a gain change of 1 per cent, which is what the 5 per cent change is reduced to. So distortion will be reduced by a factor of 5, which is 14 dB.

With the bootstrap drive circuit, and assuming the bootstrap circuit is distortion-free (which means this must be considered as a separate entity) this unity-coupled circuit reduces output-stage distortion from, say 4.3 per cent to 0.86 per cent. The reduction anticipated from the discussion of the output stage by itself gave a factor of 11, which would reduce the same distortion to 0.39 per cent.

The positive feedback of the bootstrap circuit doesn't increase the effectiveness of the negative feedback. Rather it reduces its effectiveness, allowing higher output-stage distortion. Its effect on drive-stage gain is small. Its major effect is to increase drive-stage handling capacity—is something our classic treatment of feedback did not tell us about! It does increase drive-stage gain a little, but the handling capacity is its major effect.

And the effect on output impedance is not a reduction by a factor of 11, to yield a damping factor of 11. It yields a damping factor of only 3.2. Of course, these results are subject to modification by further overall feedback.

Next — Transistor Circuits

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Jazz

BERTRAM STANLEIGH

One of the finest of the early ragtime composers, and the composer of music for three of the top Broadway Negro musicals of the 1920s, Eubie Blake had a great reputation as a pianist, but until his eighty-sixth year, there was little on records to demonstrate his talents. Thanks to John Hammond and Columbia records, we now have a two-disc set of Blake playing an assortment of his own rags, those of Scott Joplin, a couple of Sousa marches, some of his theatre music, with vocals by his old collaborator Noble Sissle, and some of the show tunes of his old friend James P. Johnson.

The composer of *I'm Just Wild About Harry* and *Memories of You* still has a flashy keyboard style with full command of the colorful effects that his instrument can produce. It must be admitted that his 1921 recording of *Sounds of Africa* in Volume III, Sounds of Harlem, of Columbia's *Jazz Odyssey* shows a stronger, more rhythmic left hand, but the effect of hearing a ranking keyboard giant of the pre World War I era in modern stereo sound is genuinely exciting. In such tunes as *Charleston Rag*, *Maple Leaf Rag*, *Eubie's Boogie*, and the *Baltimore Todolo* we can hear the flashy swagger of a style that was to have a strong influence on such artists as Fats Waller.

Born in Baltimore in 1883, Blake was already playing piano in local sporting houses by the time he was fifteen. He published his first rag, *Chevy Chase*, in 1914, and a year later began his long collaboration with Noble Sissle (their first joint effort was *It's All Your Fault*, written with Eddie Nelson for Sophie Tucker). In 1921 Blake and Sissle contributed the songs to *Shuffle Along* which was a sensational Broadway hit and opened the way for a whole series of Negro reviews on Broadway. In 1924 they wrote *Chocolate Dandies*, and with Andy Razaf, Blake wrote *Blackbirds* in 1930. In addition he contributed numerous songs to other theatre productions, including *You Were Meant for Me*, for *Charlot's Review*, the first song that Gertrude Lawrence and Noel Coward ever sang together in their long stage career.

The long set of liner notes by Robert E. Kimball, illustrated by fascinating early photos of Blake and his associates, do much to enhance this valuable jazz document. One wonders if Columbia has any further plans for taping Eubie Blake performances while this major American musical personality is still with us.

Performance: A *Sound:* A

Gabor Szabo 1969

Skye Stereo SK-9

Both as music-making and as recording, Szabo's latest disc deserves high praise. The richly expressive style of Szabo has been reflected in sensitive arrangements for an accompanying group that frequently provides secondary solos on electric organ, cello, bass, percussion, and a second guitar. Effective use of multi-channel techniques provides meaningful spatial separation between instrumental voices in an artfully contrived ambiance that has no relationship to normal listening perspective. This is use of the stereo medium as part of the art process, and the results are noteworthy.

Performance: A+ *Sound:* A+

The Sophisticated Johnnie Dankworth

Fontana Stereo SRF 67603

One of a series of new multi-track *living presence* recordings utilizing a variety of mixing techniques and multiple reverberation, this new Fontana release offers some bright jazzy, extrovert music in spectacular demonstration sound that will show off any system to good advantage. Clearly this is the Philips-Mercury group's answer to Command, Project 3, and Phase 4. Judging solely on this release, the new contender provides sound and music to equal or surpass anything else on the market.

Performance: A *Sound:* A+

HARYOU Percussion Group

ORO Stereo ORO-5

A group of 16- to 19-year old musicians who received professional guidance and encouragement under the Arts and Culture Program of the Harlem Youth Opportunities Unlimited Act perform lively Afro-Cuban music under the sensitive coaching of Montego Joe. The fifteen Black and Puerto-Rican youths display considerable talent and promise in this special recording released through ESP to demonstrate the effective work being done in training programs in the urban ghettoes.

Performance: B+ *Sound:* A−

Glenn Miller: A Memorial 1944-1969

RCA Victor Mono VPM-6019

A two-disc reissue of many of the Miller band's most popular hits in transfers that are somewhat superior to earlier reissues of the same material. Included in the thirty tunes of the collection are such items as *Moonlight Serenade, Sunrise Serenade, Tuxedo Junction, Perfidia, Chattanooga Choo Choo, Moonlight Cocktail, Kalamazoo, Juke Box Saturday Night, Serenade in Blue,* and *That Old Black Magic*. While the present collection represents less than half of the group's output, it does include almost all of the material that deserves to be perpetuated, and for anyone of this reviewer's generation it offers a double helping of nostalgia. For a more youthful audience, it must be admitted that the musical substance of these sentimental favorites is somewhat lacking. The arrangements sound dated and obvious, solo passages are meaningless cliches, and the band has less rhythmic swing than several of the well known groups of the same period. I'm afraid that most of the magic is in our memories, not in the music.

Performance: A *Sound:* B

Herbie Mann Live at the Whiskey A Go Go

Atlantic Stereo SD 1536

Not simply "live," Mann is at his liveliest on *Ooh Baby* and *Philly Dog*, the two extended pieces that comprise this entire platter. With Roy Ayers, vibes, Steve Marcus, tenor, Sonny Sharrock, guitar, Miroslav Vitous, bass, and Bruno Carr, drums, Mann tootles away in most engaging fashion. And the attentive audience listens quietly to help make this one of the most satisfactory of "on the spot" tapings. The bright, live sound has both close-up presence and a fine quality of perspective.

Performance: A *Sound:* A

Brubeck in Amsterdam

Columbia Stereo CS 9897

Recorded in December 1962, tapes of Brubeck's now disbanded quartet were somehow neglected in the CBS vaults and only recently resurrected. Made in the famous Concertgebouw, one of the world's greatest concert halls, at a live performance, the recording offers fine balance between Gene Wright's bass, Joe Morello's drums, and the Brubeck piano. While Paul Desmond's alto has the necessary loudness, somewhat distant placement of its mike leaves it a bit lacking in those reedy colors that are one of its chief delights. There can be no doubt that fine rapport existed between the quartet and audience. Brubeck is in particularly ebullient form as the group bounds through such familiar fare as *Since Love Had its Way, King for a Day, The Real Ambassador, They Say I Look Like God, Cultural Exchange, Good Reviews*, and *Brandenburg Gate*. The amount of applause that has been allowed to remain at the end of each number is irritating to this listener, but there is hardly any audience noise during the numbers, and there's no question but that the obvious enthusiasm of the crowd had a genuine effect on the performers.

Performance: A *Sound:* A–

The Velvet Touch of Lenny Breau —Live!

RCA Victor Stereo LSP-4199

Breau has made a conscious attempt to integrate the country-and-western style with modern jazz and florid flashes of flamenco. In *Indian Reflections for Ravi* he makes his electric guitar sound more like a sitar than several of the sitars that have recently cropped up in western hands. In every style, Breau impresses one with his fabulous technique, his sincerity, and his musicality. At the same time, one is aware of an intellectual process that has not been absorbed fully in his emotional expression. The result is a certain amount of self-conscious eclecticism and a straining to be individual. As he develops, we can probably expect richer rewards from this talented performer. In the meantime he deserves at least a casual audition.

Performance: B *Sound:* B

Cal Tjader Plugs In

Skye Stereo SK-10

Recorded live at the Lighthouse, Hermosa Beach, California, in Febraury, 1969, with Armando Peraza, congas, Jim McCabe, Fender bass, John Rae, percussion, and Al Zulaica, Fender piano, this set finds vibraphonist Tjader as securely inventive as ever. Romping freely against a complex percussion pattern, Tjader turns in a set of performances that deserve better recording than they get in this crowded nightclub ambiance.

Performance: A *Sound:* B

Recorded Tape Reviews

BERT WHYTE

Astrostereo Popular Program #60
Ampex/A&M, W-60, **open reel 3.75 ips,** $27.95

This is about the 7th or 8th American Airlines Astrostereo tape I have received, but until a recent flight to California, I had never heard the music in it's native habitat at 35,000 feet. On the plane the music is piped to your ears via acoustic earphones and the quality leaves a great deal to be desired. Certainly the casual traveler who is not familiar with the high-quality earphones available today, has every right to be disenchanted with the sound. Furthermore, he may erroneously blame the recording for the indifferent quality of sound he hears. Which would be a shame, for the quality of most of this airborne stereo recording is qutie good, and in the case of this album, outstanding. The tape is a composite of numbers culled from Herb Alpert's A&M label. The programming is very well done and is a virtual compendium of pop hits, with oddly enough, some Herb Alpert Christmas selections appearing occasionally. The artists on the tape include Herb Alpert, The Baja Marimba Band, Sergio Mendez, Walter Wanderly, The Sandpipers, and many others. The whole tape is characterized by the drive and ebullience of most of the selections and the sound is just great . . . big, bright, clean, with a rock-solid bass. The best compliment I can pay this tape is that although this three-hour-long production will be used mainly for background music, the quality is so good that it frequently intrudes upon your cocktail chit-chat.

The Heart of the Opera—Ampex/Mercury 19130, **open reel 3.75 ips,** $9.95

Critics love to disparage productions like this, as a vulgar sop to the great unwashed musical illiterati. Snippets of popular operas, usually of thematic material, is to them the lowest common denominator of musical taste. To top it off, these are strictly instrumental excerpts, with none of that "furrin' language singin'." Well, be that as it may, there are many instrumental sections in operas that can stand by themselves as interesting and respectable musical entities. Who will argue the merits of Salome's "Dance of the Seven Veils," Prince Igor's "Polovtsian Dances," The Trojans "Royal Hunt and Storm," the overture to "The Barber of Seville," and other pieces of similar nature on this tape? Most of the performances here are quite idiomatic with Antal Dorati and Paul Paray at the helm of the Minneapolis, London, and Detroit Symphony Orchestras. The sound on this 3.75-ips production ranges from good to excellent, except for some poor balances in the Prince Igor excerpt. Incidentally, I should point out that there is some choral work in the "Polovtsian Dances," otherwise my designation of this as all-instrumental is valid. Although this will certainly be shunned by the purists, I predict this will be a very popular tape.

Royal Fanfares at Versailles—Orchetsre de Chambre cond. by Paul Kuentz. Ampex/DGG, L9431, **open reel 7.5 ips,** ($9.95)

This is an unusual collection of ceremonial and festive music played at Versailles from the time of Louis the 14th up to the Revolution. Of the five composers listed, I am familiar only with Marc-Antoine Charpentier and Lully. All the works are quite florid in nature, with much coloristic embellishment. Sometimes in the use of high-register trumpets, you hear echoes of Bach. The music is interesting, almost aggressively gay, even if somewhat fustian. Bright clean sound here in an appropriately spacious acoustic perspective, good lateral directionality, and solid center-channel image. Hiss was quite low as was crosstalk, but the heavy steep wavefronts of the trumpets caused frequent print-through.

Lalo — Symphonie Espagnole — Ravel — Tzigane
Itzhak Perlman, violin, Andre Previn cond. the London Sym. Orch.
RCA R8S1118, **8-track cartridge,** ($6.95)

Perlman digs into the Lalo with great gusto, using it as a vehicle to display his formidable technical armamentarium. Yet with all his blazing skill he manages to imbue his performance with considerable warmth. If he does not yet have the expressiveness of a Heifetz, this should come with maturity. A hint of this is evident in his lovely graceful traversal of the Tzigane. Previn offers an entirely appropriate accompaniment, quite *en rapport* with the soloist. Balances between violin and orchestra are good, with the violin slightly favored. Nice spacious acoustics with a good sense of depth. Hiss moderate, no audible crosstalke or print-through. One of the best quality cartridges in some time, sounding excellent in my car and holding up quite well in the much quieter ambience of my home.

Franck—Symphony in D Minor, Charles Munch conducting the Boston Symphony Orchestra
RCA V8S1011, **8-track cartridge,** $4.95

Sharp-eyed readers will note the low price of the cartridge. This is one of the first of a new budget line of cartridges recently introduced by RCA. Most of the material in this new series is taken from older recordings, as for example this venerable reading of the Franck D-minor symphony. Age notwithstanding, this is a good recording and there are many other gems in this series such as the Reiner "Zarathustra." The Franck seems embarrassingly square these days, but if you don't hear it more than once a year, it can still be appreciated. The Munch performance has long been recognized as one of the best and the playing of the Boston men is superlative. Processing seems no different than full-price RCA cartridges. The only thing noticeable here is a slightly higher hiss level probably attributable to the noise level of the older masters. At the low price and the good content, these new cartridges appear to be an excellent value.

The Jazz/Rock/Soul Project — Ampex/Riverside X3048, **open reel 3.75 ips,** $5.95

This is sub-titled, "Great Performances That Paved The Way For Today's Pop Sound," and I think this is quite apt. With the like of Cannonball Adderley and his brother Nat, Wes Montgomery, Johnny Griffin, and others of similar talents, this is the quintessence of these styles of music. The playing here is, expert, elemental, and heartfelt, none of the cheap "fakey" stuff that is too often evident these days. The sound is variable . . . most of it good, but some sounds a bit restricted with some smidges of distortion. As a basic primer in the pop idiom of today, this is tops.

X-TEREO

(Continued from page 34)

Figure 3 shows the author's Xtereo system. Mattes SP200 and Acoustech III solid-state power amplifiers and a Fairchild Compander are placed on the top of the monaural center Tannoy GRF speakers for damping factor consideration. The left and right flanking Tannoy GRF Professional speakers are separated by 12 to 15 feet center-to-center with toe-in capability. The center channel is derived at the input of the main solid-state power amplifier. Thus, volume expansion can be obtained on all three channels. Center-channel balance or simulated electrical movement of the third speaker is accomplished by the balance control. The center channel is controlled by the level potentiometer. Twenty-five feet of miniature coaxial lines (RG/174-U) connect the Compander to the low impedance outputs of the Acoustech VI preamplifier. At the control center, miniature coaxial lines of short lengths are used to connect the preamplifier to a McIntosh MR71 tuner, Thorens TD124 turntable with a SME arm and an Ortofon SL-15T cartridge, and a Tandberg 64 tape deck. The tape deck has been equalized to Scotch type 201 and 203 low-noise tapes.

During the demonstration with Beethoven's Symphony No. 7 by William Steinberg, Mahler's Symphony No. 2 by Georg Solti, and Saint-Saens' Symphony No. 3 by Eugene Ormandy, the peak transient power was 55 watts each for the left and right speakers measured with a Tektronix type 547 oscilloscope. AE

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[6] Per cent distortion *versus* frequency for an AR-3 speaker. Acoustic Research, Inc., 24 Thorndike St., Cambridge, Mass.

BEHIND THE SCENES

(Continued from page 14)

it sounded nice and clean with pre-recorded cartridges and the same with the cartridges it recorded. In fact, when recording from a high-quality open-reel tape or good disc, the signal-to-noise ratio of the Telex recording was better than the commercial recorded product. The big problem with all these cartridge recorders is in timing the program and knowing where you are on the endless loop of tape. The Telex has what they call a logic circuit, which enables you to either stop at the end of each of the four programs, or play through all four programs and then stop. Blank cartridges vary slightly in the length of the tape packed in the case, so Telex suggests playing through one of the programs and timing it, so you will know exactly how much total program time you have available for recording. The main thing is to avoid cutting into program material when the head switches to the next set of stereo channels. My contribution here is that I will pass on a procedure used to record commercial cartridges. I recorded and sequenced the first several hundred classical cartridges for RCA when they first appeared in 1965.

Let us look at a typical blank cartridge. This one is loaded with 150 feet of blank tape. At a speed of 3.75 inches per second this will give you four stereo programs each of eight minutes duration. Let's assume you are going to record a pop program from a disc which typically contains five or six numbers on each side of various times and with a four- or five-second spiral between numbers. Recorded in straightforward fashion, you are likely to cut into a selection at the program change. What you do instead is to make your own dubbing master by recording from the disc onto an open-reel recorder. Most pop discs give the timing for each number. If not, time each number you have recorded on the tape. Now add up all the times including five seconds between the numbers for the spiral. Divide the result by four, and the result is the amount of time needed to record each program or sequence. In this case, the program is longer than the amount of time available on each sequence of your 150-foot cartridge. Obviously if you want the entire contents of the disc you will need a cartridge of longer duration. If you are staying with the 150-foot cartridge, you will have to eliminate some selections to make it fit. Now the best part of making your dubbing master is that you are not restricted to placing the selections in any rigid order. The thing is to manipulate the selections so they add up closest to the desired program length, in this case eight minutes. Instead of the spirals of the disc that separated selections, you are working with lengths of tape . . . pauses between selections. These can be adjusted to bring the program to it's proper timing. For example let's say we had one selection of 2:18, another of 3:00 even, and another of 2:30. They add up to 7:48. We need twelve seconds to bring the program to eight minutes, so we add six seconds after the first and second selections. The same thing is done for the other three programs, in each case varying the length of the pauses to bring the tape into balance. Now you have an open-reel tape 32 minutes in duration. You cue to the beginning of the tape, set the Telex to program one with the logic switch on four, start both machines simultaneously and every eight minutes you'll dub a program on each of the four sets of stereo channels on the Telex. Using this dubbing technique you will rarely have to cut into a pop selection. Admittedly, you have interposed a tape between the Telex and the source, but on a good tape machine there will be little degradation of the signal-to-noise ratio. Those who own Dolby recorders will have no degradation at all. With classical recordings, the dubbing-master technique is infinitely more difficult. All you have to work with is the pauses between movements of a symphony or acts between an opera plus all the various little pauses and rests found in classical music. You really need a recorder with an accurate timer where 15 inches of tape equals one second of time. The only one I know of is a $6000 Studer. With this you can run back and forth on the tape looking for splice spots without losing track of the timing. In addition to all this, bringing a classical program into balance needs the services of a master splicer. You can try a classical piece if you have the patience to undertake a very tedious job. Best thing to do is time the classical piece, divide by four and record it on a cartridge of sufficient length and grin and bear it when the program change happens to cut into Leontyne Price holding a high C.

It goes without saying that if you want to use some "off-the-air" material, you can record it directly into the Telex but at the peril of not knowing a thing about the timing. Better to record on the open-reel machine first and then do your editing, timing, and manipulation on your dubbing master and then dub the result onto the Telex.

I've had a lot of fun with this 8-track recorder and it is nice to be able to make up your own programs. AE

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You can tell it's the Opéra at Versailles when you listen with a Stanton.

The Opéra at Versailles, completed 1770, scene of the first performances of Jean Baptiste Lully's operas and ballets. (Lully was court composer to Louis XIV.) PHOTOGRAPH BY FRANZ LOSSA

The ultimate test of a stereo cartridge isn't the sound of the music.

It's the sound of the hall.

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The acoustical characteristics that distinguish one hall from another, or any hall from your listening room, represent the subtlest frequency and phase components of the recorded waveform. They end up as extremely fine undulations of the record groove, even finer that the higher harmonics of most instruments.

When a cartridge reproduces these undulations with the utmost precision, you can hear the specific acoustics of the Opéra at Versailles, or of any other hall. If it doesn't you can't.

The Stanton does.

Stanton

The specifications.* Frequency response from 10 Hz to 10kHz, ±½ dB. From 10kHz to 20kHz, individually calibrated. Nominal output, 0.7mV/cm/sec. Nominal channel separation, 35dB. Load resistance, 47K ohms. Cable capacitance, 275 pF. DC resistance, 1K ohms. Inductance, 500mH. Stylus tip, .0002" x .0009" elliptical. Tracking force, ¾ to 1½ gm. Cartridge weight, 5.5 gm. Brush weight (self-supporting), 1 gm.* Each Stanton 681 is tested and measured against the laboratory standard for frequency response, channel separation, output, etc. The results are written by hand on the specifications enclosed with every cartridge. The 681EE, with elliptical stylus and the "Longhair" brush that cleans record grooves before they reach the stylus, costs $60. The 681T, identical but with interchangeable elliptical and conical styli both included, costs $75.

For free literature, write to Stanton Magnetics, Inc., Plainview, L.I., N.Y. 11803.

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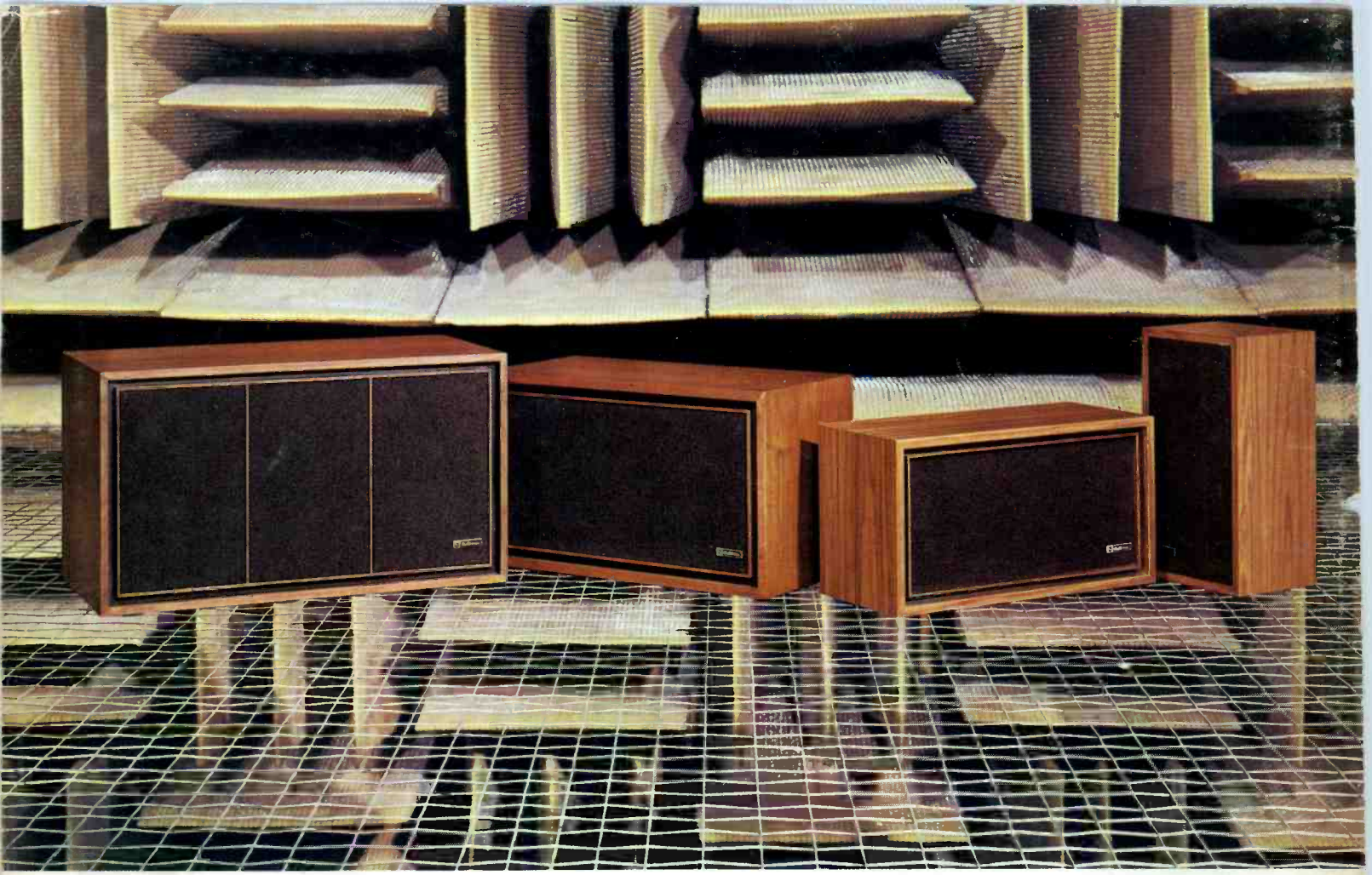

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