

23602

Canby looks
at Reissues

AUDIO

DECEMBER
1971 60c

The Authoritative Magazine About High Fidelity® A



**** Special ****
HEADPHONES
buyers guide
>>> issue <<<

A
HEADPHONE
crossfeed circuit

HEADPHONE
.... design

Behind the scenes
with Bert Whyte:
Quadraphonic
developments

A
tone burst
generator



Scott makes the best receiver you can buy for under \$400



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No matter what you plan to spend for an AM-FM stereo receiver, H.H. Scott, Inc. has a value-for-the-price leader to satisfy your highest expectations for flawless sound, convenience in use, and trouble-free long life.

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True Tangent Tracking

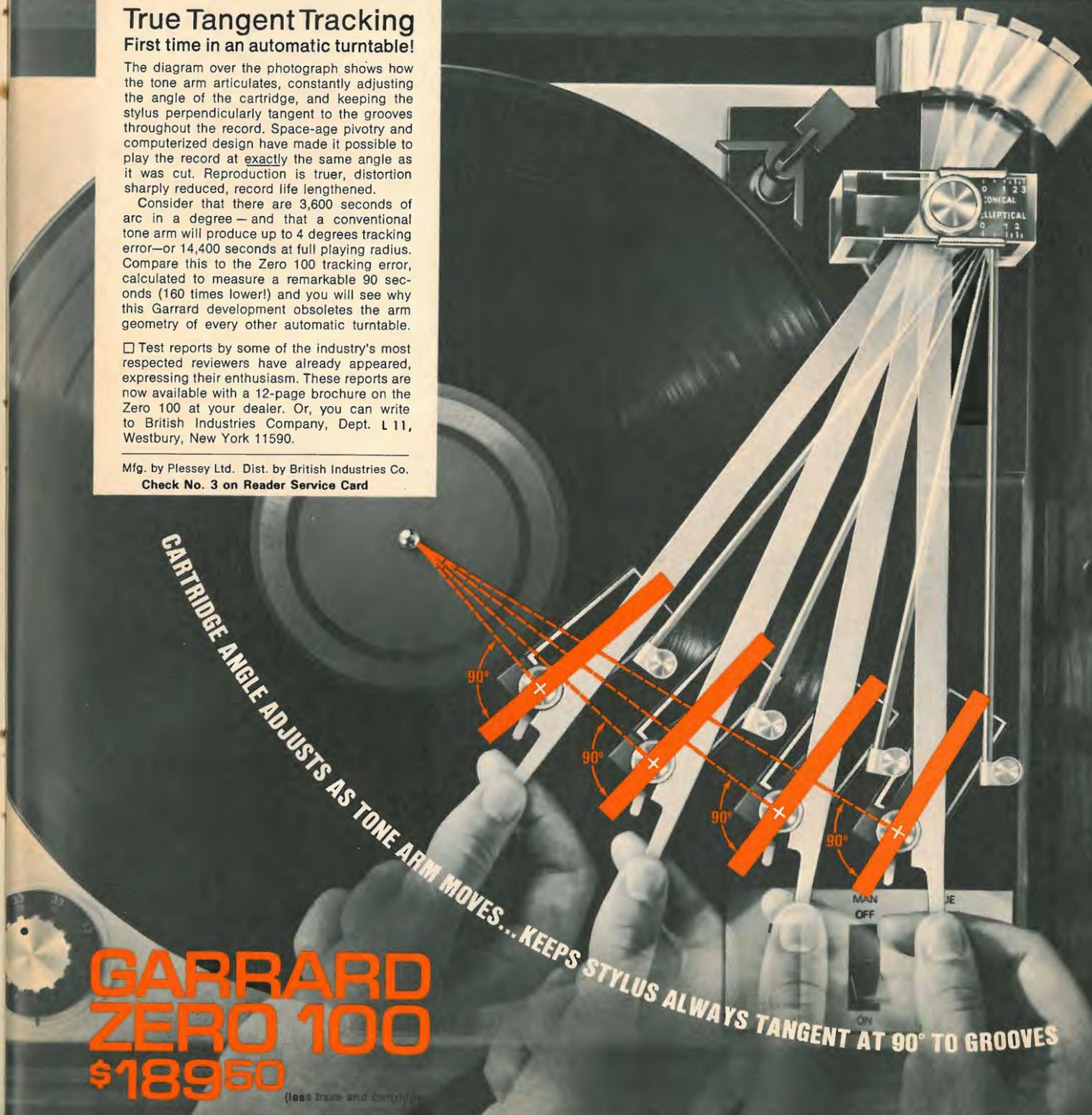
First time in an automatic turntable!

The diagram over the photograph shows how the tone arm articulates, constantly adjusting the angle of the cartridge, and keeping the stylus perpendicularly tangent to the grooves throughout the record. Space-age pivoting and computerized design have made it possible to play the record at exactly the same angle as it was cut. Reproduction is truer, distortion sharply reduced, record life lengthened.

Consider that there are 3,600 seconds of arc in a degree—and that a conventional tone arm will produce up to 4 degrees tracking error—or 14,400 seconds at full playing radius. Compare this to the Zero 100 tracking error, calculated to measure a remarkable 90 seconds (160 times lower!) and you will see why this Garrard development obsoletes the arm geometry of every other automatic turntable.

□ Test reports by some of the industry's most respected reviewers have already appeared, expressing their enthusiasm. These reports are now available with a 12-page brochure on the Zero 100 at your dealer. Or, you can write to British Industries Company, Dept. L11, Westbury, New York 11590.

Mfg. by Plessey Ltd. Dist. by British Industries Co.
Check No. 3 on Reader Service Card



GARRARD
ZERO 100
\$189.50

(less trace and control)

ZERO 100 Garrard's newest model, is the only automatic turntable achieving zero tracking error. Modestly priced at \$189.50, this most advanced record playing unit is a fabulous array of imaginative, responsible innovations: Variable speed control; illuminated strobe; magnetic anti-skating (an entirely new principle); viscous-damped cueing; 15° vertical tracking adjustment; the patented Synchro-Lab synchronous motor; and Garrard's exclusive two-point record support. An engineering triumph, the articulating tone arm, is demonstrated below.

Coming in
January

Special Receiver Issue

D. Recklinghausen and Len Feldman take a look at Receiver and Tuner specifications, design problems etc.

A Tone-burst Generator-Part III

Equipment Reviews Include:

Dual 1218 Recordchanger
Telex 2/2 Tape Deck



About the cover: Look, I said to the Artist (capital A) this issue is mainly devoted to headphones; it is also Christmas time, but please *not* Santa wearing the things—we had that last year!

The headphones are Beyer DT 480's, the stocking size 13. Both low impedance. Merry Christmas.

Audioclinic

Joseph Giovanelli

Crystal Pickups

Q. What is a crystal pickup? Is it made from glass?—Name withheld.

A. A crystal pickup is one device employed to play phonograph records. Such devices produce rather high output signals, in the vicinity of a half a volt or even more. This is contrasted with the 4 or 5 thousandths of a volt produced by magnetic pickups. In addition to its high output, a crystal pickup requires no equalization in order to obtain a respectable playback of RIAA equalized records. (All recordings made these days are made in accordance with a particular equalization curve, standardized by the Recording Industry Association of America.)

Because of the high output and its ability to reproduce discs quite well without equalization, fewer parts are needed with such a pickup than for magnetic pickups. Thus, they find application in inexpensive sound equipment. However, their reproduction is poor compared to the best magnetic pickups. Further, their compliance is quite a bit lower, and this means greater record wear.

A crystal pickup does not have glass in it. The material of which it is made is Rochelle salts. The word "crystal" stems from the structure of the molecules rather than being related to glass.

Rochelle salts as well as some other materials have the interesting property (Piezo-Electric effect) of producing electrical output when a crystal made from this material is twisted. Hence, the crystal is mounted in such a way that the stylus's motion twists the crystal, thereby producing a voltage in accordance with the modulation impressed on the record grooves.

Tuner Alignment

Q. I have a tube-type tuner which is about six years old. Should this tuner be aligned? How can I tell if the tuner requires alignment?—Harry G. Newcomer, Baltimore, Md.

A. I cannot say whether or not your tuner needs to be aligned. It stands to reason that it is not as well tuned as it once was, but it might be out so little that the change is of no consequence.

How can you tell? Well, if your weak-signal reception is not what it once was or it simply does not sound just right, lack of "cleanness" or lack of stereo separation, these are good indicators that it should be checked. Of course, poor alignment is not the only cause of these conditions. New tubes will often restore a tuner to proper working order. Sometimes aging com-

ponents make a tuner operate poorly, no matter what is done by way of alignment. If you suspect that your tuner is not performing as well as it should, the unit should be sent either to its manufacturer or to a competent service center.

Noisy Volume Controls

Q. There is a noisy volume control in my six-year-old tube-type amplifier. What can be done to correct this besides spraying the control with a contact cleaner? Shall I replace the control? Is this an expensive procedure?—Harry G. Newcomer, Baltimore, Md.

A. If you sprayed all sections of your noisy volume control with a good contact cleaner and it is still noisy, this noise might indicate that the control must be replaced, but not necessarily. If this control is fed from a coupling capacitor, and if coupling capacitor is leaking, d.c. will appear across the control. That d.c. will make the control noisy. Use a VTVM to check for d.c. voltage at the "hot" side of the control.

If the control has several sections, it might cost five dollars or more to obtain a new part, in the event that this is required. If you need someone to install it for you, labor must be added to the cost of the actual part. The amount of difficulty required to install the pot will determine that charge. The difficulty will depend on the particular amplifier.

Mike Cable for Stereo?

Q. Is there any reason why two-conductor mike cable cannot be used for a stereo connection rather than two separate audio lines; the ground is common anyway? Will such use introduce cross-talk?—Harvey W. Kunz, Old Tappan, N.J.

A. I suggest the use of two separate audio lines rather than one two-conductor line for stereo installations. There could indeed be some cross-talk as a result of the capacitance between the two inner conductors and it possibly could be a significant amount. However, why take chances? Dual conductor cable is fine when you are using balanced lines or when the shield is not used to return the signal to ground. This practice is often followed in an effort to reduce hum.

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.

Stanton quality is a very special quality... in headphones too.

The headphone is, after all, a speaker system for the head.

And the new Stanton Dynaphase Sixty is an advanced two-way speaker system designed for heads instead of shelves. Its unique, extremely wide-range two-way dynamic reproduction system is acoustically mounted with a separate woofer and tweeter. A special crossover network precisely channels the highs and lows into each ear, creating a truly breathtaking feeling of presence.

In keeping with the high quality approach to the design of the Stanton Dynaphase Sixty headphone, the fully adjustable headband and softly cushioned earpieces are stitched (not heat-sealed). Stanton even improves convenience in amplifier connection and disconnection by providing a

larger and specially designed plug. A simple blue-black and chrome color scheme adds the quality finished touch. \$59.95.

Stanton Dynaphase Forty, a high-performance economy version of the Dynaphase Sixty with wide range single speaker system is also available. \$39.95.

ACCESSORIES
Stanton Model 5741 control unit—The most convenient in-

line control unit ever developed for headphone listening. Works with Stanton Dynaphase headphone systems as well as with other headphones. Lets you control listening at your location by providing separate volume and tone controls and a stereo-mono switch. Complete with 17-foot coiled cord, it acts as a perfect extension accessory. \$19.95.

Model 5742—Separate 25-foot coiled extension cord works with all headphones. \$7.95.

For complete technical data write Stanton Magnetics, Inc., Terminal Drive, Plainview, N.Y. 11803



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Manufacturers of the world famous Stanton Calibration Cartridges and the renowned Isophase Electrostatic Headset Systems.

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ELECTRO
STATIC
STEREOPHONES



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- Decorator-styled, walnut control console.
- Dual polarization capability, self-energized and 110V line AC.
- Left and right channel volume controls.
- Separate ground — one for each channel.
- Control console accommodates two PEP-71 headphones.
- Model PEP-77C complete system, price . . . \$99.

See your dealer or write for details

SUPEREX
ELECTRONICS CORP.
151 Ludlow St., Yonkers, N.Y. 10705

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Tape Guide

Herman Burstein

Scope As VU Meter

Q. Can you refer me to any written source which will explain how the vertical axis of an oscilloscope may be used in place of a VU meter in tape recording?—C. J. Woodlock, Chicago, Ill.

A. The October, 1968 installment of the Tape Guide in AUDIO discusses the use of a scope as a record level indicator.

Head Replacement

Q. Not long ago I bought a tape deck. While the instruction manual does give recommended maintenance procedures, there is no mention of replacing the heads due to wear. I have been replacing my magnetic cartridges yearly, and I would assume the tape heads also need replacing. What is your opinion?—Arnold J. Kiner, Newark, N.J.

A. It is quite difficult to formulate rules based on usage for replacement of tape heads. Heads can last anywhere from a few hundred hours (if that much) to a couple of thousand hours or so before new ones are needed. Much depends on the quality of the head and on design of the transport in terms of the way the tape passes across the heads (pressure pads, tape tension, wrap angle, etc.). The best procedure may be to have performance of the tape recorder checked periodically, say once a year, and to replace heads in accordance with what the performance check indicates. On the other hand, there may be times when your ears can indicate replacement is needed, for example if treble response on playback becomes poor; this suggests that the gap of the playback head has widened and the head must go. First, however, make sure that treble loss isn't due to dirty heads, magnetized heads, or poor tape-to-head contact.

Parallel Recording

Q. Several of my friends and I get together often to copy each other's records and tapes. We were hooking up our source to the input of tape deck #1, the output of deck #1 to the input of deck #2, etc. But we found that successive decks produced tapes with more and more hiss. I went home and soldered up a wire harness which would take five decks at one time in parallel. Now will each deck draw so much signal as to cause the signal to deteriorate? We all have Sony 355 decks.—George B. Moore, APO Seattle.

A. Inasmuch as the output of your tape machine is low impedance while

the inputs are high impedance, you can probably connect several recording decks at once to the output of the playback deck. If there is interaction, you can isolate the recording decks from each other by putting a resistance of something like 100,000 ohms between each recording deck and the signal source.

Bias Adjustment

Q. My questions concern the use of a 1 KHz signal generator to obtain an optimum bias setting for a particular tape on a tape recorder having external bias level controls. According to what I have read, the 1 KHz signal is recorded and, with the VU meter set to read output, the bias is adjusted for the maximum output signal; then the bias is backed off 1 db from maximum. But these accounts have all been less than perfectly clear about the last step.

1. How should the back-off of 1 db from maximum output be achieved?

(a) By setting the VU meter to the "bias read" position after maximum output in playback is achieved, and then lowering the bias level 1 db?

(b) By changing the bias until the tape output is reduced 1 db from maximum?

2. If 1(b) is the correct answer, how should the 1 db reduction in tape output below maximum be achieved?

(a) By decreasing the bias level?

(b) By increasing the bias level?

What is ± 1 db as read off a VU meter ± 1 VU?—Ernest Lumer, Brooklyn, N.Y.

A. To adjust bias in accordance with your procedures, the correct answer consists of your statements 1(b) and 2(b). That is, adjust bias until you obtain maximum playback output at 1 KHz. Then further increase bias until the playback level drops. Sometimes it is suggested that bias be increased until playback level drops 1/2 db; and others, like your manufacturer, suggest a 1 db drop. The optimum course depends on what happens to treble response. If a rise in bias that causes 1 db drop in output at 1 KHz results in excessive treble loss, then use slightly less bias.

On a true VU meter, a change of 1 VU corresponds to a change of 1 db.

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

Sound like the pro you'd be if you were recording for money instead of love.

If you're serious about tape, the TEAC 3300 is a tape deck you can take seriously.

It'll accept 10 1/2-inch reels, like a professional deck, for up to 6 hours of recorded material. And it has professional features you won't find on any other tape deck for the price. \$499.50.

Like the new Front Panel Bias Switch for the proper selection of bias current and recording equalization for either conventional tapes or the new low noise/high output tapes.

And expanded scale professional-type VU meters for each channel. The wide excursion scales simplify recording at higher (up to 6dB) signal levels, a must when using the new tapes, assuring better signal-to-noise ratio and an expanded dynamic range.

Another is TEAC's unique Edi-Q, an electronic pause control; it interrupts taping but keeps the recording amplifiers on and ready, eliminating recording clicks and tape bounce during quick-start operation.

Of course the 3300 has the kind of professional specs you'd expect from TEAC (after all, we make the professional

systems too) — S/N: 58dB, wow and flutter: 0.06% and frequency response: 25–24,000Hz (± 3 dB; 30–20,000Hz) at 7 1/2 ips.

Before you spend your money on any tape deck, spend some time with the TEAC 3300. At your dealer's.



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TEAC

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TEAC Corporation, 1-8-1 Nishi-Shinjuku, Shinjuku-ku, Tokyo, Japan
TEAC EUROPE N.V., Kabelweg 45-47, Amsterdam — W.2, Holland In Canada: White Electronic Development Corp., Ltd., Toronto

Various head configurations and speeds are available to fit every need.

What's New in Audio

Pioneer QM-800 amplifier

This four-channel power amplifier has four independent level meters, the sensitivity of which can be adjusted in three stages, 0 dB, -10 dB, and -20 dB. Output is claimed at 25 watts rms per channel with a bandwidth of 10 to 50,000 Hz. Damping is specified at 70, while hum and noise are better than -90 dB. THD and IM distortion are both rated at better than 0.5 per cent. Price: \$299.95.

Check No. 6 on Reader Service Card



Literature

Folkways/Scholastic Records offers its catalog of music, foreign language, social studies, and language arts records, together with a listing of audio-visual equipment.

Check No. 10 on Reader Service Card

Bruel & Kjaer has released its 1971/1972 short-form catalog of acoustic measurement instruments. Included are artificial ears and voices, audiometer calibrators, filters, frequency response tracers, noise generators and monitors, plus a wide variety of transducers and instruments.

Check No. 16 on Reader Service Card

Revox with Dolby system

The A77 Revox tape recorder is now offered with a built-in Dolby B noise reduction system. Speeds are 7½ and 3¾ ips, while claimed frequency response is 20 to 20,000 Hz +2 -3 dB. Wow and flutter is specified at 0.08. Two VU meters are standard as is 10½-in. reel capacity. Price: \$799.00.

Check No. 11 on Reader Service Card



Ampex 220 cassette accessory

This combination head cleaner and demagnetizer performs both functions on any normal cassette player in 30 seconds without abrasive tape-head contact or electrical connection. Price: \$4.95.

Check No. 8 on Reader Service Card



New Classic disc storage unit

This anti-warp record storage unit holds discs upright with a system of spring-loaded pressure pads, which keep pressure accurate within ¼ oz. Already warped discs can be straightened in a special position of the rack, and up to 100 records can be stored safely. Size is 15¼ x 13¼ x 13¼ in. Price: \$19.95.

Check No. 12 on Reader Service Card



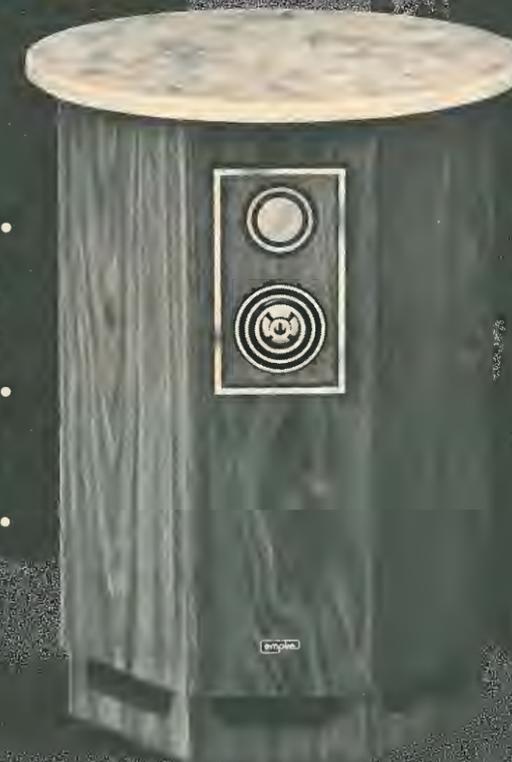
Sony SS-4200 loudspeaker

This three-way acoustic suspension system combines an 8-in woofer with an 8-in. mid-range driver and two 3-in. dome-cone tweeters. Frequency response is said to be 50 to 20,000 Hz +5 dB. Dimensions of the oiled walnut cabinet are 13¼ x 23¼ x 11½ in. Price: \$95.00.

Check No. 9 on Reader Service Card

Empire's most exciting Grenadier

DESIGNED TO
OUTPERFORM ANY SPEAKER
UP TO TWICE THE PRICE
new model
7500M



Three Way System •

15 inch woofer
direct radiator mid-range
ultra sonic domed tweeter

Wide Angle Dispersion •

360° spread for lows
160° at high frequencies

High Power Capacity •

100 watts power per channel

• Extended Response

25-20,000 Hz.

• Elegant Pedestal Enclosure

20 inch diameter
26¾ inches high

• Irresistibly Low Priced

at \$169.95; with imported
marble top \$184.95

Wait until you hear this great speaker. Listen to the kind of sound no box can deliver. In Empire's stereo cylinder the woofer faces down for bass so live it gives you goosebumps. There is no ugly grill cloth; the handsome finish goes all the way around and the marble top is meant to be used. Empire's

Grenadiers are available in satin walnut or antique oak finish.

For information and further details, write Empire Scientific Corp., 1055 Stewart Ave., Garden City, N.Y. 11530.

empire

Dear Editor

Out, Out Damned Scratch

Dear Sir:

I have long been dissatisfied with the ease with which LP discs scratch. There must be a solution to this problem within our technological and commercial reach. I have given some thought to this problem and would like to put forth the following suggestions.

There are two approaches to making a surface scratch resistant. One approach is to make the surface harder than the scratching substance. To apply this to record surfaces would probably result in an LP that would be both fragile and expensive. The second approach would be to employ a surface material that is relatively soft but resilient of elastic. Perhaps polyethylene or another type of plastic would do. If the plastic used on the surface was too flexible to support its own weight (i.e. drooping on the spindle), then a composite structure could be designed with a central rigid core. Why not?

Francis C. Lowell
Huntington, N.Y.

London's Golden Barrel

Dear Sir:

I have been reading again the February review of London's opera reissues on their Richmond label. I do not question Mr. Freed's obvious knowledge of the subject, but I feel that his finely-honed sensitivity resulted in recommendations by him that I am rather glad I disregarded—preferring to put my faith in London's reputation. So many of us are unaware of all the fine points that take the pleasure out of Mr. Freed's listening. This fact is a boon to the survival of music performance before audiences all over the world.

If these Richmond recordings were poor-sounding hash-ups of original so-so engineering—a consideration with AUDIO readers—one could go along with Mr. Freed's advice to pass many of them by. But technically, London has always led the field, and here we have finely disced, full-bodied stereo recordings of often stirring performances by very good professionals. The repertoire, moreover, is an infrequently performed sector of the best Grand Opera. And Mr. Freed would "kill the goose that laid the golden egg."

Until these records came along I had not had the opportunity of hearing *Khovantchina*, *Prince Igor*, *Pique Dame*, *Eugen Onegin*, or *Alceste*. I did have a

Flying Dutchman and *Die Frau Ohne Schatten*, but I found the Richmond releases quite superior. My library has been enriched without making too great a dint in the pocketbook. Another consideration.

With soaring production costs limiting the making of classical records, it could be years before these works are recorded again. But if it ever happens, there will probably be some critic who will refer back to these as a preferred choice.

If this is "scraping the bottom of the barrel" by London, to quote Mr. Freed, I hope the bottom is wide and many more such "scrapings" remain.

Norman D. Taylor
San Rafael, Calif.

How We Really Test

Dear Sir:

Why don't you really test the equipment you print reviews on?

Van Trafton
York, Pa.



Heart-Felt Issue

Dear Sir:

Being an ardent AUDIO subscriber to these many four years (and an avid AUDIO reader even longer), I was thrown into panic when I did not receive my February, 1971 issue. I changed my address about that time, and . . . well, you know, anything can happen when one changes one's address.

I love my AUDIO so much that I have been taking them to a bindery to preserve them in book form. Well, sir, if I don't get that February issue somehow, then someone someday is going to be angry when he looks on the library shelf for the February 1971 issue, sees that it is missing, and then looks on the inside cover of these bindings and sees

that some idiot named Paul McGregor donated these magazines to the library back in '91. The library will get a bad name, my memory will live in infamy, . . . libraries have been sacked and burned with lesser justification than that.

In addition, I am genuinely interested in the contents of the missed issue. Please advise as to whether I could obtain it and at what price.

Paul M. McGregor
Clarksville, Tenn.

We'd hate to have anyone think you were an idiot or to have your name live in infamy, and we pale at the thought of libraries being sacked and burned. But worst of all would be an angry, frustrated AUDIO reader, searching for a copy of the February, 1971 issue.

Sir, you have melted our stony heart. We are enclosing a copy of that issue at no charge and we hope that you like it as well as the others.

Incidentally, though it isn't generally known, we do sell bound volumes and they can be ordered around year's end from our Subscription Manager, Mrs. Jean Davis.—Ed.

Kudos for Whyte

Dear Sir:

I recently spent one of the most pleasant days of my career in high fidelity, listening to a variety of tapes at the home of Bert Whyte. I was mesmerized by the naturalness of the sound and by his eloquence and professionalism.

Bert is truly one of the most exciting people in this industry. His knowledge of music, recording techniques, and all aspects of high fidelity is overwhelming. He is truly the dean of audiophiles, and now that I know him personally, I will read his articles with even more enthusiasm than in the past.

Leon Kuby
Harman Kardon, Inc.
Plainview, N.Y.

To The Editor

Dear Sir:

AUDIO is extremely informative and worth its weight in gold.

James H. Sauerbier
(U.S.A.F.)
Portsmouth, Va.

According to our calculations, this would be \$208.53 at the present price of gold. Checks should be made payable to North American Publishing Co., Inc.—Ed.

THORENS manual



TD-125AB

PE automatic



PE-2040

The best of both whirls

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EVERY FALL in New York we get two things . . . a touch of Indian summer and the annual convention of the Audio Engineering Society. Unfortunately, these events usually coincide to the day, and in the stuffy confines of the New Yorker Hotel exhibit space, the affair turns into a soggy saga of too many people and too little air conditioning.

Ah, well! For anyone interested in professional audio this convention is a must, which transcends the inconveniences of weather and the paucity of creature comforts. Every year the product exhibits seem to expand. The mezzanine was crowded with booths, as was the grand ballroom, part of the third floor, and an "overflow" on the seventh floor. In various hospitality suites "behind the scenes" (no plug intended) one could view prototypes of new equipment, while bending a convivial elbow. It would be nigh impossible to mention all the new equipment at the show, so I'll just cover the highlights which I found of particular interest.

Rupert Neve Co. of England (and now of Connecticut too), builder of fantabulous studio mixing consoles, had the prize-winning exhibit of the show. The Neve people had built one of the first quadraphonic mixing consoles for Vanguard Records several years ago. At the show they installed the latest version of their four-channel mix console, plus an Ampex MM1000 16-track recorder, plus 16 Dolby 361 noise reduction units and a pair of Koss headphones. Presiding over this intimidating array was John Woram, the affable mixmaster and manager of Vanguard Records studio operations. Previous to the show John had done a 16-track recording of about a 40-piece group, doing some rather avant garde pop/rock music. After threading the two-inch-wide tape into the Ampex, John invited people to sit down at the Neve console and have a go at a mix. Shades of Walter Mitty! Here you are confronted by this gleaming array of controls. Channel after channel of sliding faders . . . multiple echo send and return . . . equalizers and VU meters. The strings, brass, woodwinds, piano, bass, guitars, percussion and voices are all assigned specific

tracks. The 16 faders are in the off position, and while nominally you can mix 8 tracks to the left and 8 to the right, you can intermix at will, and of course with pan-potting can make a four-channel mixdown. In fact had there been a four-channel recorder added to this set-up, this could have been accomplished. As it was, one randomly selected track number 2 and increased the gain with the smooth-as-silk sliding pot. In the left earphone a guitar is heard. Now we bring up the gain on track 14 and a trumpet sounds out in the right earphone. We select track 6 and some strings join the guitar on the left. Track 11 yields some percussion on the right. Soon you are utilizing all 16 tracks and some 40 musicians are playing for you. Each track is beautifully isolated and totally controllable. With the Dolbys there isn't a smidgen of noise. It suddenly occurs to you what tremendous flexibility is available to today's recording engineers with such consoles and multi-channel recorders. You also have a heightened appreciation of the skill of a John Woram for his positioning of the various instrumentalists and his selection and all-important placement of microphones. As you can imagine, hundreds of people enjoyed playing "engineer" on the Neve console, including my wife. All in all, a unique experience and a tip of the hat to all involved.

Strolling down the exhibit hall, I come to the Crown International booth. There is the familiar DC300 amplifier, but what is this hulking brute next to it? Oh, no! Gadzooks chaps, would you believe the Crown M600 featuring 600 watts rms at 8 ohms and 1000 watts rms at 4 ohms? Or it's bigger brother (not shown) the M2000 with 2000 watts rms at 4 ohms? These are mono amps with delivery slated for April of next year. Why such massive power? Who needs it? The significant thing is that both amplifiers have high voltage output (70 V for the M600, 140 V for the M2000) for distribution lines to drive multiple speaker loads. Needless to say, these will find use in discotheques and outdoor functions. Can such brutes be used in the home? Certainly unlikely in the average situation but in certain circum-

stances, and approached with a healthy admixture of respect and trepidation, they might prove useful and interesting. Being a sportin' type, I may have a go at them one of these days! Diagonally across from Crown I spot the Nagra booth which has large signs proudly proclaiming the advent of a stereo version of their famous portable recorder. The standard Nagra has been the workhorse for synchronous motion picture recording for many years. Now the unit has been updated for stereo, possibly in response to the Stellavox recorder I reported on in April, 1970. The Nagra 4-S features its well-known closed loop servo drive, with 15, 7½ and 3¾ ips available. There are such nice touches as phantom powering for Neumann, Schoeps and Sennheiser mikes, a pushbutton 1KHz square wave reference oscillator to check azimuth, and a limiter to handle an extra 6 dBs input level. There are other goodies too numerous to mention here. If you have ever seen a Nagra recorder, you know it epitomizes what is meant by "Swiss precision." I expect to have one of these Swiss jewels before long and have some dandy recording ideas in mind. Tantalizing thought . . . two Nagra units can be coupled together for continuous recording. Now if there was some way of keeping the two units in sync, we could make such things as outdoor four-channel stereo recordings!

In the Gotham Audio exhibit, the highlight was a demonstration of the Delta T delay unit. This completely solid state device accepts analog signals, converts them to digital and stores them in a memory core, and then lets them be retrieved as analog signals with delays ranging from 5 to 320 milliseconds in 5 mS increments. There are many studio and public address applications for such a device, but much more fascinating as far as I am concerned is its use in the synthesis of four-channel sound. Based on the Haas precedence effect, you can take regular two-channel stereo recordings, feed them into the unit, delay them somewhere between 10 to 50 mS, and then feed the delayed signals to two more amplifiers and a pair of speakers in the rear of your room, or in some circumstances

How we saved our new \$139 speaker from medium-priced boredom and conformity.

Ordinarily, there's nothing more boring than a medium-priced speaker system.

Low-priced speakers can be exciting because a few exceptions sound better than they have the right to. And high-priced speakers are, of course, endlessly fascinating because each expresses a different designer's concept of the "state of the art."

But bookshelf speakers in the \$110 to \$150 range? When you've heard one, you've heard them all.

That's why, having already created some of the world's finest low-priced and high-priced speakers, we decided that something distinctly new and different should be done for the music lover with a middle-sized stereo budget. The result was the **Rectilinear XII**.

First of all, we did something about efficiency. Unlike the conformist acoustic-suspension speakers in this price range, the **Rectilinear XII** is a high-efficiency tube-vented bass reflex system. All you need is 10 clean walls to drive it to ear-shattering levels. So you won't need a high-priced amplifier or receiver to enjoy your medium-priced speaker, even if you like to feel those bottom notes right in your stomach.

Then we did something about *time delay distortion*. The **Rectilinear XII** reacts faster to an input signal (it "speaks" sooner, with less time delay between electrical input and acoustical output, and with less lag between drivers) than any other cone-type speaker system except our own higher-priced

models. Rectilinear seems to be the only speaker manufacturer to be concerned about this type of distortion, but the difference it makes is easily audible to any critical listener.

A nonconformist approach to crossover design is largely responsible for the superior time delay characteristics of the **Rectilinear XII**. The 10-inch high-excursion woofer is crossed over to the "fast," low-inertia 5-inch midrange driver at 350 Hz, a much lower frequency than is conventional in three-way bookshelf systems; the 3-inch tweeter takes over at 4000 Hz. To compound the unorthodoxy, we abandoned

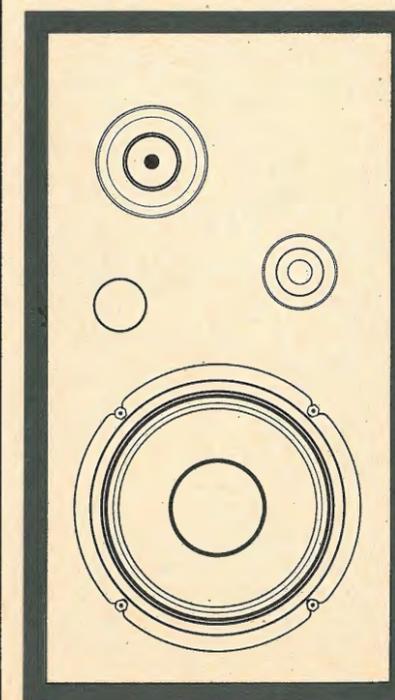
the customary parallel-type crossover network in favor of a very elegant series configuration, which gave us vastly improved phase response.

Finally, as our ultimate defiance of tradition, we listened objectively to our own speaker. Did it really sound as different as we had set out to make it? To our ears (which, after all, have a good track record), it did. The **Rectilinear XII** seems to reproduce music with a clarity and authority that few speakers, at any price, can even approximate. And certainly none at \$139.

But this is something that each prospective buyer must decide for himself. So, if you're shopping in this price range, listen carefully to the **Rectilinear XII**. And, please, be cynical, jaded and hard to please.

For your \$139, you're entitled not to be bored.

Stop in at your local high fidelity dealer for a demonstration of the **Rectilinear XII** or any of our other speaker systems, priced from \$79.00 to \$299.00. For more information, including detailed literature, write to Rectilinear Research Corp., 107 Bruckner Blvd., Bronx, N.Y. 10454. Canada: H. Roy Gray Co. Ltd., Markham, Ont. Overseas: Royal Sound Co., 409 N. Main St., Freeport, N.Y. 11520.



Check No. 14 on Reader Service Card

two speakers abeam of you on each side. I am expecting a Delta T unit within a few days and will ultimately give you a full report on my experiments.

In the Presidential Suite of the New Yorker (no less), 3M was showing a prototype of a new 16-track recorder. There is quite obviously a trend towards smaller, less physically intimidating units, considerably more compact than present multi-track recorders. Among many features, most notable was the use of solid state switching instead of the conventional relays, a "fail-safe" track monitoring system wherein if a malfunction occurs in a particular track, a warning light comes on at the specific track pushbutton. In the bottom of the recorder console, are 16 Dolby modules, exactly the same size as standard Dolby modules, and the recorder's VU meters

manufactured by Vega and rated at 500 watts rms per channel (Gasp!) Now these cats had some rock music on tape, featuring a really heavy Fender bass and when they turned that monster loose, it was beyond belief. They claim the speaker is capable of 500 watts continuous duty, and I can tell you that this lad is not about to refute them. The sheer gut-thumping acoustic output was STUPENDOUS!! You literally can have your suit dry-cleaned just standing in front of it. Furthermore, this elephantine sound is reproduced quite cleanly. No one in his right mind could stand more than 20 or 30 seconds of this sonic assault . . . especially if he makes his living with his ears! However, I understand more than a few nuts have ordered them for their homes. Presumably they live in the Kalahari desert. If in this

track recorder. Here too, the trend is to smaller units. For one thing the doghouse containing amplifiers and VU meters as used in the MM1000 is gone. Now the VU meters are directly in front of the unit, level with the top plate, and in the production model will be tilt-able, to accommodate both remote control recording and recording at the unit. Amplifiers in modular form are in the bottom of the console. The new unit is really "under wraps" so other details are hard to come by. More info when I can squeeze it out of my friends at Ampex. Ampex was also showing a neat link-up between a movie projector and an MM1000 16-track recorder. Absolute sync is established, but there are manual vernier type controls so that minor adjustments can be made, especially when dealing with lip-sync in foreign language overdub prints.

Teac was showing their new SL line of recorders, with the 7030 of most interest to the pros. The top-of-the-line Dolby box was also shown, but alas, this model has been sitting in the holds of ships on the West coast because of the dock strike . . . thus no samples for test.

I've saved the Electro-Voice exhibit for last, because it will lead into the next story. At E-V they were playing records with their four-channel matrix system . . . BUT this time, with the addition of a new logic circuit developed by Peter Scheiber, who as you probably know has joined forces with E-V. Peter demonstrated the system switching the logic in and out. As far as I am concerned, this form of sophisticated gain-riding, or manipulation, certainly enhances the degree of separation between the four-channels. The matrixed four-channel stereo sound field when the logic is operating would satisfy a great many people as a reasonably close approximation of discrete four-channel stereo.

As noted there were many other things at the AES show which reflected the growth and increasing sophistication of audio, and I am sorry that space does not permit a more detailed presentation.

Close on the heels of the AES convention, a meeting of NARAS (National Academy of Recording Arts and Sciences) was held at the Columbia Records 30th Street studio in New York. The purpose of the meeting was a presentation by CBS and Electro-Voice of their respective four-channel stereo disc matrix systems. Some called the demonstrations more of a confrontation, than a presentation or "entertainment," and as it turned out, there was an element of truth in this. Understand now, the

(Continued on page 72)

AUDIO • DECEMBER 1971



EVX-444 Decoder

are used for calibration purposes. 3M has acquired the Micom Company, well-known manufacturer of flutter bridges, and is now offering new improved models of this important measuring tool.

On the seventh floor I was on my way to visit the AR room when the wall next to me shuddered and thrummed with a tremendous outpouring of sound. The sound emanated from the room of Vega sound systems (not to be confused with the Vega wireless mike people). On entering the room, I found myself in the lair of a manufacturer of loud-speaker systems for use by rock groups and in discotheques. By gad, Harry, you wouldn't believe what they have put together! Standing close to six feet high each were two speaker systems, utilizing special 18-inch woofers in a back-loaded folded-horn configuration, horn-loaded mid-range, and exponential horn tweeter. These highly efficient speakers were driven with amplifiers also man-

power-mad rock world, this unit should be found wanting . . . Vega is ready for them, as they showed a prototype 24-inch woofer, a battleship gray unit built along the same lines. The mind not only boggles at this . . . it simply gives up!

At the AR room they were playing their new professional model the LST, which contains the same cubic footage as the standard AR3a, but is configured in a different manner. A bit "squatter" than the AR3a, there are panels on each side of the main section, angled at approximately 30 degrees to the rear. At \$600.00 each, the hoped-for market is for professional monitoring in studios at high levels, but as you can well imagine, many AR enthusiasts are ordering them for home use. In any case the speakers were very clean and smooth and gained greatly in projection with their higher output.

At the huge Ampex display, they were showing a prototype of a new 16-

If you've got the jack, we've got the cassette deck.

No matter how big your room, or how small your budget, Panasonic has a stereo cassette deck that can fit right in.

Jack in our compact model, the RS-256UAS. It has a lot of the features our bigger, higher-priced decks have. Like easy-to-work pushbutton controls. A digital counter. Fast forward and rewind. Plus two large VU meters. They tell you when you're recording at just the right levels. And Auto-Stop to shut off the machine at the end of the tape. So your tape won't get damaged.

The RS-256UAS even has a special noise-suppressor switch to cut off those grating hisssses. And Pause Control. So you can

turn off the Grand Funk Railroad without turning off the machine.

Of course, the bigger your pocketbook the more you get. When you jack in the RS-270US, you get Memory Rewind. Preset the machine. And it automatically returns to a particular spot on the tape. There's even a tape selector switch. To let you play low noise, as well as conventional tapes.

Then there's the RS-272US with its own special trick. Automatic reverse. It switches tracks automatically. So you can listen to twice as much Bach without getting off your back.

But maybe money isn't your problem. You want all the cassette deck that you can get.

Then your franchised Panasonic Hi-Fi dealer can show you the RS-275US. It has a combination of features no other deck can match. Like sensitive, long-lasting, Hot Pressed Ferrite heads. And two motors. One is direct drive for record and playback. The other is for fast forward and rewind.

All of this adds up to a signal-to-noise ratio of better than 45dB. A frequency response of 30-15,000 Hz. Plus wow and flutter of less than 0.1% WRMS. And it's all at your fingertips with our solenoid touch controls.

So if you've got the jack, just see your Panasonic dealer. He'll show you how to get beautiful music out of it.



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Editor's Review

YOU MAY have noticed that headphones are getting more and more popular as amplifier power is creeping up. This is not really cause and effect and I suspect that the main reason for increased sales of headphones is due to the tremendous improvements which have taken place over the past few years. Not so long ago headphones were cumbersome, heavy and the sound quality was pretty poor. Usually no bass and an enormous peak in the upper midrange! No doubt about it, present day models are a pleasure to wear (some weigh less than eight ounces), and frequency response and distortion are comparable with the best loudspeakers. In fact, some say better!

Quadraphonics

The October issue probably annoyed a few readers who are not now interested in four-channel sound—but it *did* inspire many favorable comments. John Eargle, now of Altec, said it performed a great service for the industry and this sentiment was echoed by several others. One of the objects of publishing details of the various matrix systems was to help in a small way towards standardization. As we go to press, E-V's Larry LeKashman announced a modified version of their Stereo-4 decoder which will permit it to be used with CBS SQ records—without switching. A step in the right direction.



The Berliner Award

Congratulations

Congratulations to Garrard for winning the 1971 Berliner "Maker of the Microphone" award. As most people will probably guess, the product concerned is the new "Zero 100" turntable with its ingenious tonearm. The Award was

established in 1963 in memory of the great pioneer, Emile Berliner, and it is given annually "for an outstanding contribution to the world of sound." Recipients include Roland Gelatt (1963), Dr. Olsen (1965), and AUDIO magazine (1967). It was fitting therefore, that among the speakers at the ceremony which took place at the N.Y. Statler-Hilton was Charles McProud. The award, incidentally, was presented to George Thompson-Gordon of Garrard by Emile Berliner's grandson, Oliver.

New York Audio Society

Next meeting will be held on December 15 at the Dragon Seed Restaurant, 37th Ave., Jackson Heights, N.Y. and the time of 8:00 p.m. is underlined in the note! The speaker is Bill O'Connor of TEAC who will demonstrate various tape recorders, including the new cassette unit with built-in Dolby system. Address of the Society is 215 Adams St., Brooklyn, N.Y. 11201.

For Manufacturers

Makers of hi-fi equipment wishing to export to Great Britain will find a great deal of useful information in a recently published comprehensive survey called "Audio in Transition: A financial assessment of the British Industry and Market." It can be obtained from Finnresearch, Ltd., 30 Baker St., London, W1m 2DS. Price is \$45.00.

* * *

I see that I referred to Gene Fiebich of Heathkit as "Chief Engineer." In fact he is Director of Engineering*. There is a difference as this position has a much wider responsibility. It can be said that a company president must plan for five years ahead, a director of engineering four, a chief engineer two, and a project engineer one. Unlike the old British Indian civil service, it is not just a matter of prestige; in *that* elite group, promotion was indicated by office size, carpet area, then the allocation of a mahogany toilet seat, and finally at the topmost rung—a flagstaff in the garden!

A Merry Christmas and Happy New Year from all of us at AUDIO.

G.W.T.

* And Vice-President.

Choosing the wrong cartridge for a record player is like putting low octane gas in a high-performance car.

Here's how to choose the right cartridge.

Matching stereo cartridges to turntables and record changers is as important as putting the right kind of gas in your car. Low octane gas just won't work in a high performance car. And high octane gas in an economy car is a waste of money. It's the same with cartridges. In fact, a cartridge that's great for one system could be disastrous for another.

So, we've developed a simple way for you to precisely match one of our XV-15 cartridges to whatever kind of record player you have

or plan to buy. It's called the Dynamic Coupling Factor—DCF for short.

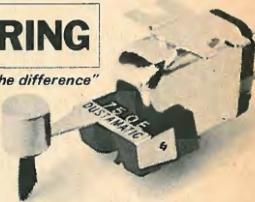
DCF is a numerical index, like an octane rating, that our engineers have assigned to the XV-15 cartridges by pre-analyzing all the electrical and mechanical specifications of all major record changers and turntables. The more sophisticated the record player, the higher the DCF number.

But how we devised the DCF rating system isn't as important to you as knowing what it does. Using

our DCF chart to choose your XV-15 makes sure that you get optimum performance when you play your records. And that you can walk into your high fidelity dealer and know just which XV-15 to ask for.

After all, you don't just drive into a gas station and ask the man to "fill 'er up", do you?

PICKERING
"for those who can hear the difference"
101 Sunnyside Blvd.,
Plainview, N.Y. 11803



Cut out this handy DCF Guide.

IF YOU OWN	MODEL NUMBER	Use a Pickering XV-15 cartridge with this DCF Number	
		ELLIPTICAL	SPHERICAL
Acoustic Research	XA	750, 400	350
Benjamin Miracord	50H, 750, 770H	750	350
	40H, 40A, 40, 630, 620, 610, 18H, 10, 10F, 10H	400	
Dual (United Audio)	1219, 1209, 1019, 1215, 1015, 1015F	750	350
	1009SK, 1009F, 1009	400	
	1212, 1010A, 1010	200	150
Garrard (British Industries)	SL95B, SL95, SL75B	750, 400	350
	SL75, LAB80MK11, LAB80	400	350
	SL72B, 70MK11, A70, 60MK11, SL65B, SL65, SL55B,	200	150
	SL55, SP20B, SP20, A, AT60, AT6		
	40, 40B, 50MK11, 50, 40MK11, 40Autoslim, Autoslim/P, T11, RC98, 210, 4HF, 301, RC80, RC88	140	100
Lenco	L-75	750, 400	350
McDonald (BSR)	600, 610, 500A	200	150
	510, 500, 400, 310	140	100
Pioneer	PL-30	750	350
	PL-25, PLA-25, PL-41C, PL40F, PL-41A	400	
Perpetuum-Ebner	PE-2018, PE-2038, PE-2020, PE-2040	750, 400	350
Sony	TTS 3000, PS 1800A	750, 400	350
Thorens	TD 125	750	350
	TD 150AB, TD 124	400	

Elliptical styli, because of the way they rest in the record groove, track with less radius distortion, and therefore are capable of playing records in good condition with less overall distortion.

Spherical styli are more rugged and can be used with higher tracking forces.

Check No. 17 on Reader Service Card

A Christmas Story...



SANTA CLAUS swore softly and, jumping up from his Danish Modern teak chair, he switched off the Heath AR-15, which died with a burst of static and a peevish growl from the Bose speakers. "Not a damn FM station within miles," he muttered as he brushed a reindeer hair off his elegant Hart, Shaffner, and Marx suit. (If you thought Santa Claus always went around in that old red cloak—you must be out of your mind!) Pouring himself a generous helping of Johnny Walker Black, he pressed a button and in a few moments his miniskirted secretary came in.

"Sit down, Miss Kahn, and tell me what my engagements are for this week."

"Well, yes," said Miss K., crossing her shapely legs. "Nothing much today. It just says 'S' in my note book and I really can't remember . . . but tomorrow"—she brightened visibly—"tomorrow you have a Bar mitzvah. The Grossmans, of West, um, Westchester."

"Yes, I know," said Santa, raising his glass. "I promised and I will be there. Remind me to pick up a New York map at the gas station. How about Wednesday?"

"Yes," said Miss Kahn. "You have a man from IBM coming to sell you a 370 computer."

"Right," said Santa. "The four we have now are overloaded. Thursday I know; I have the Japanese trade delegation, but how about Friday?"

"I have Mr. Bernie Brown, the attorney for Santa Claus Franchises, Inc.—10:00 a.m."

"Um, better put him off until Monday. I have a lot to do Friday. I want to wire up a new quadrasonic system at home." Stretching out his long legs, he gazed at his size 13 Florshaims and then looked at the blank TV screen on the wall. "I wonder," he began . . . but he was interrupted by Miss Kahn.

"I know what 'S' is—it's your son."

"Yes, yes," said Santa (who always talked that way). "I want to see that young man. Check those tax figures. I'll be back later."

And so Santa heaved himself up and with a brief nod to a signed photograph of Paul Klipsch, he went out into the corridor. Frowning slightly behind his beard, he walked past the walnut doors marked "Production Control," "Public Relations," "Accounting," "Dr. Kuby—Psychiatrist," and several inscribed in Chinese, Swahili, and other languages he couldn't remember. Then, opening a large steel door right at the end, marked "STORES, Sect. xv-655-B," he passed Dolls, German; Dolls, Japanese

and a smaller section; Dolls, American and making a left hand turn to a door inscribed in gold letters, "Santa Claus, Jr." Two seconds after he knocked, this same door was flung open and a disheveled blonde rushed out and disappeared behind a huge pile of cartons labelled "Stereo Headphones, Clarke-Koss."

"Hullo, Dad," said Junior. "I was just checking the Harvey invoices and . . ."

"Yes, yes," said Santa testily, waving his hand towards the door. "I saw you were, but I want to have a serious talk with you."

"Not that again!" said Junior, who was dressed in a Gimbel's Young Man of the Seventies Ensemble in violent purple and yellow. Santa looked puzzled. "You know, the old birds and the bees jazz," mumbled Junior.

"No, no," said Santa. "I want you to get more involved."

"Involved?" was the reply. "Don't I wear a Peace badge, didn't I scuff the bottoms of my pants, didn't I carry a protest . . .?"

"No, no," said Santa. "I want you to get more involved in the business. I want to retire."

"Retire? What will you do?"

"Never mind that," answered Santa, as he picked up a copy of Rolling Stone and hastily put it down again.

Junior scratched at an egg stain with his beads and finally asked, "When do you want me to take over?"

"November," was the reply, "before the busy season. We will have staff meetings next week to discuss all the details." And as an afterthought, "I will be available as a consultant for a year or two."

Pausing to look at his son's downturned moustache, which looked even sadder than usual, he averted his eyes from the purple and yellow and went out. Picking up an E-V Stereo-4 unit from a shelf, he slowly returned to his office, happily whistling the slow movement from Tchaikovsky's 6th into his beard.

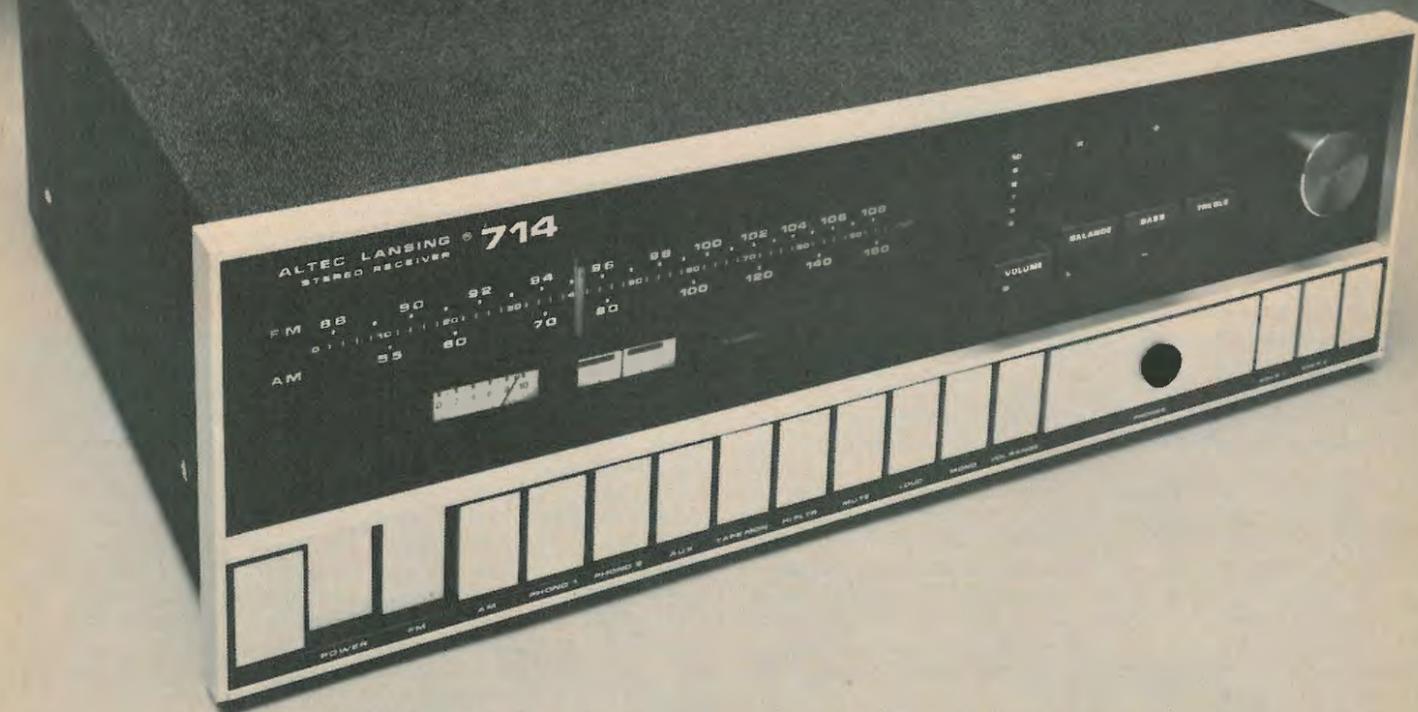
So, in due course, Junior took over the reins (and reindeer) and presumably the change is working out without undue strain. As for Santa, well, he is now the proud owner of a hi-fi store somewhere between Syosset, N.Y. and Tenafly, N.J. The exact address? No, I'm keeping that to myself; after all, where else can I get Pioneer, Sansui, and Fisher components at 30 per cent off? Merry Christmas!

T.W.G.

Test reports in both HIGH FIDELITY and STEREO REVIEW prove the Altec 714A receiver is built a little better.



In February, HIGH FIDELITY magazine printed a detailed two-page test report (by CBS Laboratories) on the Altec 714A stereo receiver. The wrap-up comment read as follows: "All told, the 714A is one beautiful piece of audio machinery that should be given a long serious look by anyone in the market for a new high-quality stereo receiver". And in January, STEREO REVIEW'S equipment test report (by Hirsch-Houck Laboratories) stated, "In its general performance and listening quality, it is comparable to the best we have tested..."



The Altec 714A AM/FM stereo receiver delivers 44/44 watts of RMS power at less than 0.5% distortion (180 IHF music power). And for high FM sensitivity, it features 3 FET's and a 4 gang tuning condenser. Plus, 2 prealigned crystal filters and the newest IC's for better selectivity and more precise tuning.

The Altec 714A sells for \$399.00. Hear it at your Altec dealer. Or, write for a complete Altec catalog and copies of available test reports. Altec Lansing, 1515 S. Manchester Ave., Anaheim, California 92803.

Check No. 19 on Reader Service Card

Concert Hall at Home



H. L. Schmidt*

IN THE PAST headphones were looked upon as strange devices found only on board ships in the wireless operators' cabin or draped over the head of the captain of an airliner. To use headphones for high fidelity reproduction was unthinkable! With the desire to achieve the best in reproduction, coupled with an ever-increasing amount of research in acoustics, headphones have come a long way from the wireless cabin and can be found today in the living room of many penthouse apartments. With little detail and skipping all the fancy mathematics, I will try to show why this strange phenomenon has taken place. Initially the question may be asked,

why use earphones when there are so many very good loud-speaker systems available? What may not always be apparent to the general public, and something that has plagued engineers for many years, is that in a given room acoustics can be either good or bad and are usually very bad. It is understandable that most of us could not afford to design our living room around our sound system or go to the extreme of listening in an anechoic chamber.

Our home listening area is by no means a concert hall, and again, because of the differing levels of background noise, children running back and forth, the wife vacuuming, we end up with what engineers call poor signal-to-noise ratios. Because of all this, we start looking for some other way to reproduce our favorite classics or jazz in total realism and hopefully undisturbed.

Before we go any further, let's note one other little problem which has crept in, channel separation. Here some skeptics will say we go too far with earphones, in that we leave the so-called "hole in the middle" without any sound. To this we could reply that the opposite can easily take place in the living room when using standard speakers, since with all the varying acoustics, we may well end up with good or bad stereo separation. In fact, if we were able to see some of the frequencies, we would say that separation was very poor.

But when we come to earphones, we have a means of establishing a standard of separation. For some listeners this may be too much; for others it may be perfect. For those who find the separation too great, we can use one of the either simple or very complex networks of which there are many on the market. These blend portions of the left and right channels, and thereby fill in the hole in the middle to a greater or lesser extent. (See *Improved Headphone Listening* by Linkwitz in this issue.)

With all the advances which have been made in acoustical research, engineers have found it possible to produce a smooth, crisp sound from well below 20 Hz to well over 15,000 Hz. One extremely important reason for being able to reproduce below 20 Hz is the development of liquid earseals, which properly seal the phones to the side of the head. Added to this are the large cup design, special cavities, and special sound absorbing materials from the plastics field. Taken together, we have a means of developing a headphone which will reproduce sound and reject ambient noise to an extent that could only be dreamed of a few years ago.

In Fig. 1, I have shown the frequency response of an average pair of six cc headphones. To control the accuracy of measurement, standard acoustical Bruel and Kjaer equipment and an ASA 6 cc artificial ear were used. Figure 1 also shows us what happens when a number of subjects wearing the 6 cc

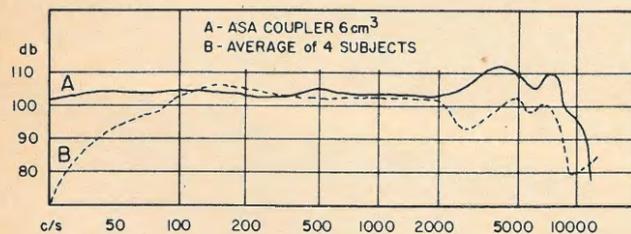


Fig. 1—Response curves of standard 6/cm³ earphones.

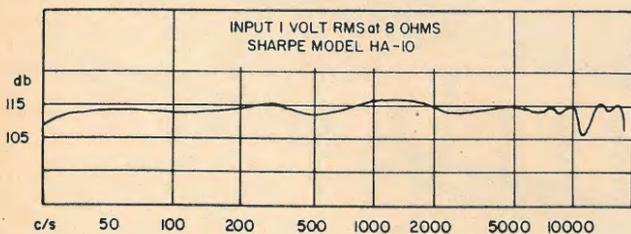


Fig. 2—Response curve of a Sharpe production headset.

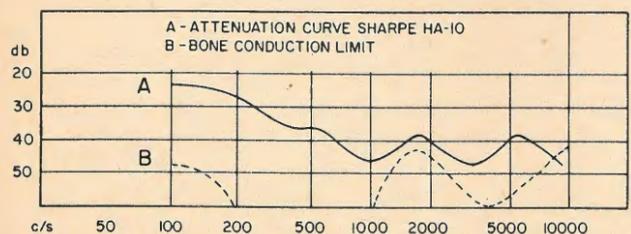


Fig. 3—Ambient noise reject curve.

headphones listen to various frequencies with a constant amplitude. From evidence shown here, we can see why the use of headphones to reproduce high fidelity sound was very unpopular.

Simply stated, with the standard type of headphone the low frequencies could not be retained, which in fact was the same as removing the bass section from an orchestra. Additionally, many of these standard phones were of the magnetic driver design, which at best limited reproduction to below 7,000 Hz and in most instances to only 5,000 Hz. Lastly, we were still subjected to an extremely high amount of ambient noise, since there was no means of reducing it.

Tackling the problem of ambient noise rejection first, it is apparent that some means must be used to either completely plug the ear, or at least enclose it. Since completely enclosing the ear is more practical, we are left with the large circumaural-type cup assembly, fitted with the liquid earseals. This provides us with some control over the rejection of ambient noise and we also have a large cavity which can be used as a portion of the reproducing system.

Figure 4 shows what evolved from many hours of research and development. Examining our drawing, you will note that we have the earseals, the large outer cup, dynamic driver, a plate called the cavity divider, driver cavity, earplate, high frequency resonance attenuator, and medium frequency damping material. Looking at the driver first, we see this is enclosed in the driver cavity and mounted on the cavity divider, which in turn is mounted on the earplate assembly—this is what we call our driver-cavity assembly. The rear portion of the driver is airtight in its seal, via the mounting of the driver cavity. The driver cavity serves to prevent any out-of-phase low frequency cancellations. In addition, the driver cavity has its internal space so calculated as to establish a particular resonance which can here be loosely called our *crossover frequency*.

The dynamic driver appears to be nothing more than a miniature loudspeaker, though it is apparent that a considerable amount of engineering skill has gone into the mechanical shape, the choosing of the magnet strength, and more particularly into the shape, density, and composition of the cone used on this driver. I might add here that the free air response of this driver is 500 Hz to 14,000 Hz.

Inside the driver cavity we note also that some of the medium frequency damping material is employed to damp out reflections within this area itself. In addition some control of the resonance of this assembly is provided by this damping material.

Going further, we see the cavity divider is a ported type assembly. The port openings did not simply evolve from a mathematical equation, but required in addition a considerable amount of trial and error. Were it not for the medium frequency damping cushions, all the frequencies emitted by the driver would be permitted to circulate in the area of the large cup by means of the ports. This of course would be a disadvantage in that certain frequencies would be enhanced and others would deteriorate. Through careful selection of the medium frequency damping material, we are able to effectively control the internal volume of the large cup. In simple terms, we can look at this foam damping material as appearing or disappearing, depending on the frequency.

Now let us examine the area closest to the ear, where we note the high frequency damper and, directly in front of our driver, another high frequency resonance attenuator. To some it may be obvious that these two are selected so as to damp out reflection. That is, when listening to music, certain sounds will be reflected from the side of our head or portions of our ear and these reflections will change the phase relationship of the sound. This phase relationship can serve to strengthen or to reduce certain frequencies, which would appear on a

swept frequency response curve as dips and peaks. The acoustical damping material is of course selected with an eye towards further reduction of these reflections.

One could say this development is all well and good, but how do we know these figures are correct or at least reasonably correct? I would like to state here that an *absolute* means of measuring the frequency response of a headphone still lies in the distant future. But thanks to the scientists' work, we do have some means of correlating figures. In the design and construction of our headphones, we use two methods in measuring frequency response. The first is what we call the flat plate coupler and the second is a probe tube microphone.

The probe tube microphone is a small, 1/8 in. diameter microphone, mounted on the end of a probe and inserted between the headphone and our ear. This then gives us a relative measurement of overall frequency response. The overall frequency pressure response of this microphone extends to well above 40,000 Hz, varying just fractions of a decibel over the total spectrum.

The question may arise, why not use the ASA 6 cc, (cubic centimeter) coupler since we refer to the human ear in terms of 6 cc? If we look very closely at the design of the headphone in terms of acoustic volume area, we find that the area varies from approximately 12 cc to as much as 120 cc. There-

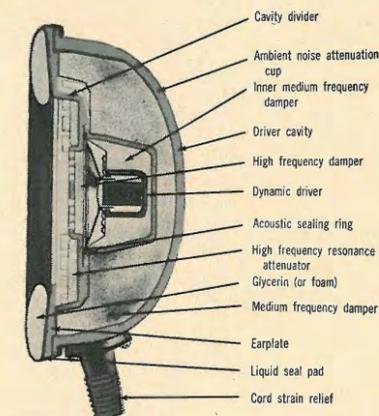


Fig. 4—Construction of a modern high fidelity headphone.

fore any measurement which we might make on a 6 cc coupler would be incorrect. The combination of the flat plate and the probe tube approach permits us to design our headphones with a reasonably flat frequency response. Again, I refer to the curve in Fig. 2.

For the reader's information, Fig. 2 is standard for various models by Scintrex. Additionally I have shown an ambient noise attenuation curve for the large cup-type circumaural phone.

I must apologize to our more technically inclined readers for not having delved more deeply into the theories and mathematical equations involved in the design of these headphones. I would like to refer these readers to "Acoustics of Circumaural Earphones" by Drs. E.G. Shaw and G. J. Thiessen. Both these gentlemen are with the Division of Applied Physics, National Research Council of Canada, Ottawa, and were instrumental in the development of the liquid earseals and the dual cavity system used in the headphones described in this article. Special thanks are due to the laboratory staff at Scintrex Limited and to Mr. Stan Rose of Foamade for his help in developing some of the acoustical material, and to Mr. E. Kawaguchi of Fujiki Electric for his help in the development of the driver used in this headphone.

References: *Acoustical Engineering*, by Olsen. *Acoustics of Circumaural Earphones*, by Dr. E.G. Shaw, Dr. G.J. Thiessen, National Research Council, Ottawa, Can.

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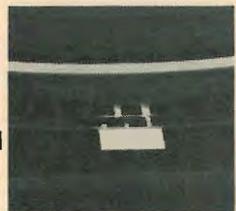


The original ELAC/Miracord 50H hasn't just proved itself. It's proved to be a classic. So we've improved it. With the new 50H II.

We gave it new flexibility in

speed control. Not just by letting you adjust your records' speed and pitch by 6% (a semitone), but also by building in an illuminated stroboscopic speed indicator that lets you return to absolute pitch accuracy at will. Because without that stroboscope, a pitch control would have you listening more often at the wrong speed than at the right one.

And we improved the rack-and-pinion counter-weight adjusting system to make it even more convenient and easy to adjust.



But when we added these improvements, we kept everything else that had made a classic of the original 50H:

The Papst hysteresis-synchronous/motor, proved in thousands of 50H's—and in more thousands of professional studio tape recorders around the world. Because hysteresis motors keep their speed up even when the power goes down (in brownouts, for instance).

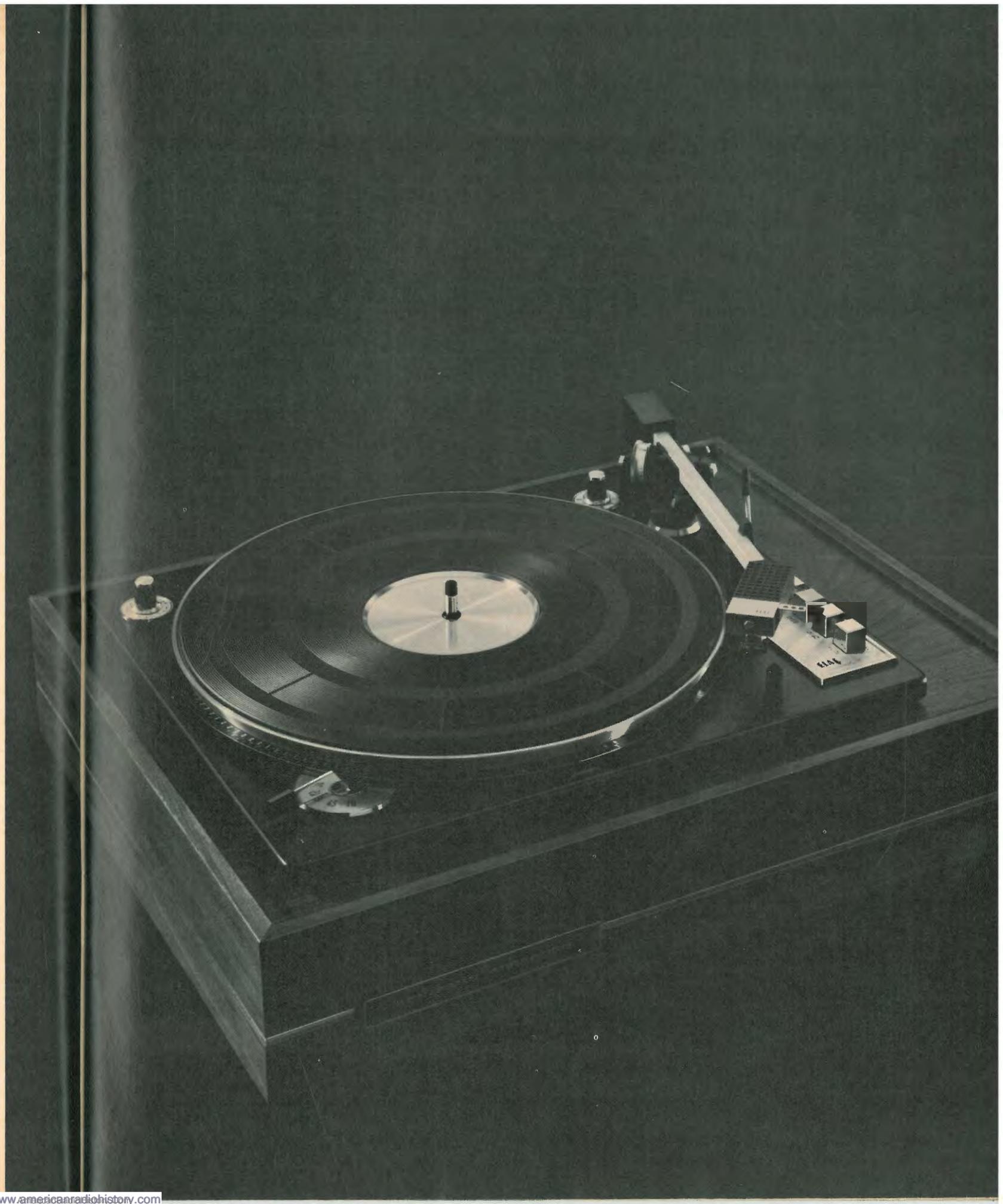
The metal cam that holds its precision, unchanged, through thousands of hours of play. And the leadscrew tracking-overhang adjustment, still the simplest and easiest in the field.

The 50H II is priced at \$199.50. And for those who still cherish it, the original 50H is still available at \$175.

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Dynamic and Electrostatic Headphones



Howard Souther*

WHILE THE SUBJECT of this discourse concerns listening through headphones, to understand the subjective significance of their performance we must employ comparisons with the perception of musical sounds in real existence. Further, we will help this effort by contrasting headphones perception to that obtained from loudspeakers. Additionally, we will elaborate on the differences between the listening modes—monaural, binaural, stereo and, yes, even four-channel “surround” sound.

The earliest reproducer was a single earpiece, which included a small electromagnet consisting of a coil of wire and an iron core with a 2- or 3-inch steel plate suspended over the end of it. The electrical counterpart of the signal passing through the coil winding induced varying amounts of magnetism in the core. This in turn vibrated the suspended steel plate, moving the air and making sound. The quality of these early phones was poor because the musical range was quite restricted. However, these phones served in communications work for many years, the present telephone receiver being a not so improved version.

Monaural Sound

The sound from early phones was characterized as *monaural*, and even when two earpieces were combined into a headset, the sound had no dimension nor depth. The best description of the effect would be that of listening to the music through a window, or, perhaps, listening with one ear at the microphone location.

Binaural Sound

When two microphones are employed, spaced and separated as are one's ears and each microphone feeds its own headphone, a tremendous effect of realism is obtained, although the sound

seems to be realized “in the middle of the head” and slightly above the median line of the ears. The effect is pleasing, although reality is not duplicated, since there is no movement of the head permitted relative to the sound source.

Ordinarily, recordings are not made with this microphone spacing, for to achieve dramatic spatial effects with loudspeaker playback, a different pickup technique must be invoked.

Stereo

In stereo recordings microphones are widely spaced to favor instrument groups. Stereo listening through speakers is as different from “binaural” as binaural is from real life listening.

The finest loudspeakers reproduce about 8½ octaves of the musical range out of a possible 10. When one speaker is placed to the right and the other to the left, the directional effects of the concert field are simulated in the living room. Even the sound emanating from the center of the field is synthesized by the blending of the sound from two speakers.

A cross-referencing center in the brain of the listener evaluates the intensity, quality, and arrival time of the sound from two sources in an instantaneous, composite and unconscious function. This allows him to determine that the sounds come from the left, the center, or the right. According to the loudness and reverberant quality, the listener also perceives whether the sounds are from the near distance or from far away. These things give three dimensions to the music and place the listener in the same position as the audience to produce a powerful effect of realism.

The art and science of acoustics provides tools and techniques which can enhance reality. It was Leopold Stowkowski who once said, “If I had a thousand bass viols, I could use them all.” This points up one of the many

limitations of real existence—and now we suggest something better.

The exclusion of distracting sounds, coupled with the proximity of the musical information received is only a part of the improvement over speakers and, yes, over real life listening too.

The plan (Figure 1) shows that however preferential his listening position, the conductor is too close to some instruments and too far from others, so that he must interpret, rather than hear, the actual musical balance. He compensates partially by bringing the soft playing harp in close, so that he can detect the delicate plucking. The inefficient violins are adjacent, with the concertmaster only arm's length away. Not so the bass viols. Their physical size and number demand a distant situation, in spite of their weak, but important low, grave tones.

The best efforts of the most famous maestro are vastly improved upon by the recording engineer when the phonograph record is produced. The recordist, using individual microphones placed in each orchestral section, augments and monitors the dim harp. He moderates the over-intensity of the clamorous

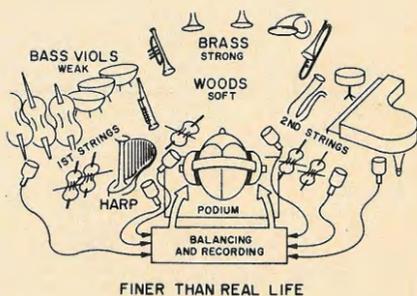


Fig. 1—This diagram illustrates the manner in which the headphone listener receives balanced sound levels from all parts of the orchestra.

This new receiver cleans your signal, without cleaning out your bank account

It's a dirty world out there. And even though an FM station transmits a clean signal, by the time it reaches your house, it may be mixed up with 20 or so other signals, and some interference sources, many of them strong enough to swamp the signal you want to hear. The new Sony 6045 FM stereo/FM-AM receiver spares no detail to deliver a clean signal to your speakers.

Its FM front end uses *passive* r.f. circuitry, so that those strong, but undesired signals can't overload the input, to swamp your station or to pop up at several random places on the dial. (The passive input stage can't generate any hiss, either). By the time the signal does reach an active stage, most of the undesired signals have been shorn away—and since that stage is an FET, it's virtually immune to overloading anyway.

Six solid-state i.f. filters clean the signal even further. They combine uniform response over the entire FM channel with almost complete attenuation everywhere else. You can pluck the station from a host of stronger ones or adjacent frequencies. And solid-state i.f.'s never need realignment. Together, these ideally-matched FM circuits provide:

2.6 uV (IHF) sensitivity, 70 dB signal-to-noise ratio, 80 dB of selectivity, 100 dB of spurious signal rejection, and a capture ratio of 1.5 dB—all at a total harmonic distortion of only 0.4%. AM performance is equally outstanding.

Cleanliness doesn't stop at the 6045's tuner stage. Its amplifier uses the same dual-power-supply, direct-coupled approach as our more expensive amplifiers and receivers, so there's no coupling capacitor to stand between you and the music. The 6045 gives you the best sound your speaker is capable of, because you get the full damping factor at all frequencies, and perfect transfer of all 75 watts dynamic power output* at only 0.5% distortion. Noise at full output is a miniscule 0.13 millionths of a watt, virtually inaudible. Still, no matter how clean the receiver's circuits, some stations still put out a dirty signal, some records are worn or scratched and some tapes have hiss. The 6045 has an answer for that one, too: a high filter that cleans such signals up.

Price is not a dirty word either. It's inexpensive. In this day of rising prices, it's just clean miraculous. Sony Corporation of America, 47-47 Van Dam St., Long Island City, New York 11101.

SONY 6045

*IHF standard constant supply method at 8 ohms.



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brass. He increases the normally deficient bass section, thus accomplishing a musically balanced performance almost impossible to achieve in real life.

Through stereophones we gain the finest listening position, that of the conductor himself, and through disc recordings bypass his problem of interpreting proper balance of the instruments over near and far distances.

Here, then, through stereophones, and the scientific wizardry of the acoustics engineer, is the means of appreciating music far beyond the composer's most impossible desire.

Four-Channel Sound

Currently there is extreme interest, not to mention controversy, in *four-channel sound*, where left, right, left rear, and right rear signals are recorded and played back from the four corners of the room. Peculiarly, if the listener faces the center front and holds his head very still, there is no certainty that sound comes from the rear, although the ambience effect has been enhanced, perhaps because the two extra speakers have assisted high frequency dispersion. Movement of the head, of course, permits rear directional effects. The illustration may disclose why increased "surround sound" effects are achieved with speakers, and suggest that maybe headphone stereo listening has had the "surround" effect right along.

Observe in the illustration (Figure 2) that if the listener is blindfolded and faces the center between two speakers while the head is held steady, the virtual sound originating 20 degrees to the right cannot be differentiated from sound at 167 degrees, or from *behind the listener!* (1)

If, while listening to four channels with four speakers the head is moved 30 to 40 degrees to the right, the right rear channel becomes the "right" channel, and the left rear channel the right rear channel. Thus, a new localization of the sound to the front is achieved, but the origin of the *rear* sounds remain in question. It may be interpreted that in real life a visual clue is required to determine front and rear sounds unless the head is rotated. It has also been shown that visual clues are required for determining "up" and "down" sounds. While the two ears do a creditable job of establishing left, center, and right, and the brain evaluates intensity and reverberation to determine near and far distances, to hear rear sounds (without head movement), and to hear sound from "up" or "down," we may need a total of six ears situated on each plane of the head!

Because the headphones turn with the head, movement does not assist in

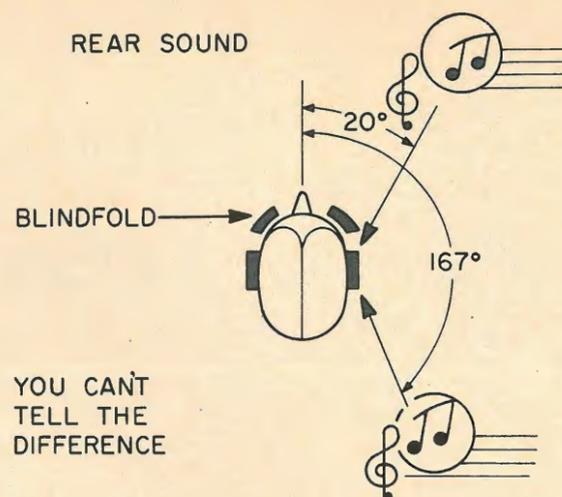


Fig. 2—When a blindfolded listener holds his head steady, rear sounds cannot be differentiated from front sounds. In this case a source 20 degrees off the axis also may be localized at 167 degrees.

ANALOGIES HELP DESIGN

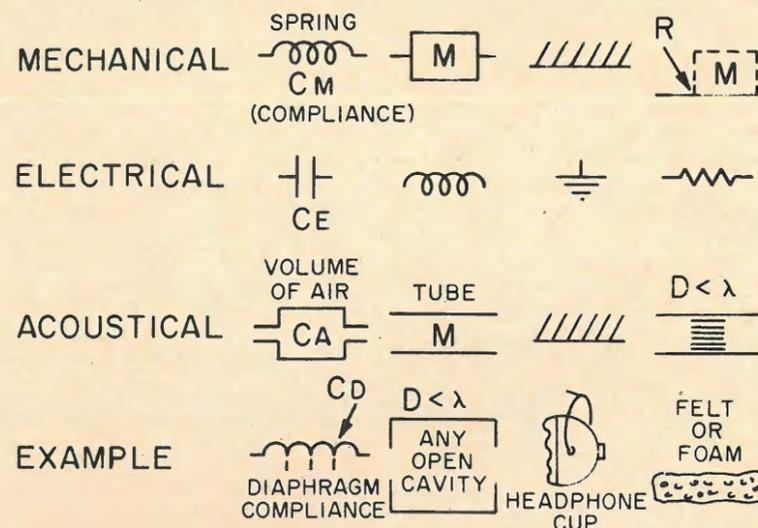


Fig. 3—Mechanical, electrical, and acoustical analogies. Mass is the mechanical element which opposes a change in velocity. Inductance is the element which opposes a change in current. Resistance is the electrical dissipative element. Friction is the mechanical dissipative element. Capacitance is the electrical element which opposes a change in the applied force. Compliance is the mechanical element which opposes a change in the applied force. It should be noted that in a mechanical or acoustical system, the capacitive element always must have one side grounded.

determining "rear" sounds. However, the superior ambience effects, which lend so much to pleasing listening, have always been present in headphones with two channel recordings and now show possibilities of enhancement with the ambience added by four channel techniques.

Tools for Design

The design of headphones is as much an art as it is a science. However, the

art is ably assisted by the body of knowledge in mechanics and electricity. If this exposition serves as intended, the reader can become an expert and himself execute a good headphone design. Using as a tool the table of analogies illustrated in Figure 3 and by employing the considerations to follow as a base, a creditable headphone will result.

Before designing a headphone we must choose the method of operation. There are two of these, velocity and

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Actually we found there was something missing in everyone's line. No one had a really high powered, high styled receiver for a reasonable price.

And you asked for one. So we did the only human thing. We built the S-7300 AM/FM stereo receiver. The Missing Link.

The S-7300 has 160 watts (IHF) — 42 + 42 watts R.M.S. at 8 ohms, both channels driven, with only 0.6% distortion. Plus, solid state ceramic FM IF filtering and 1.8 μ V FM sensitivity. We included inputs for two phonos plus mikes, and, provision

for up to four tape recorders. There are illuminated selector indicators, and one special feature: an oiled walnut cabinet at no extra charge.

Normally, it costs up to \$400 to get all these features. But we wanted a truly evolutionary receiver.

So we priced the S-7300 at just \$319.95.

It's priced just above our best selling S-7100, just below our top-rated S-8900. But in the \$300 price range, no other receiver has more power, features and styling than our new S-7300.

Ask your audio man to demonstrate our Missing Link. The evolutionary S-7300 AM/FM stereo receiver.

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pressure, and we will explain the advantages of both. (See Fig. 4.)

The velocity design is light in weight, and defined as "supra-aural," which means that it rests on the ear. This class of phone is smooth in response and gives good sound. It does not exclude outside sounds, and thus lacks the virtue of complete involvement with the performance because of the inclusion of ambient noise.

The pressure operated headphone is "circum-aural." This means that the headphone cushion surrounds and seals the aural cavity. It rests on the head around the ear and scarcely touches the sensitive "pinna" or cartilagenous parts of the external ear. The circum-aural feature excludes outside noise and is very comfortable, although it makes for a somewhat heavier headset than the velocity type. The response range of pressure phones can be very wide, and for this reason they may be preferred.

How Velocity Phones Work

It is a nature of all physical things to vibrate at a fundamental frequency more easily than at any other. For example, a 3-inch disc of aluminum, 2 mils thick, suspended from a string in free space, if struck a sharp blow will resonate at about 1 kHz. (See Fig. 5). The mass, or inductance, and the compliance, which is analogous to electrical capacity, forms a resonant circuit resulting in high efficiency. If the disc were infinitely light and infinitely stiff (the "ideal" loudspeaker membrane operating in free space), the response would be weak at low frequencies (zero capacity or compliance) and increase at 6 dB per octave without limit as the frequency went up (zero inductance or mass). Under these circumstances, the sound would be shrill, just like that of a magnetic or velocity phonograph cartridge plugged into the auxiliary amplifier input instead of the velocity equalized cartridge input. The remedy in a velocity design is to apply mechanical equalization to our headphone to offset the shrill sound. Here is the way we go about it:

First, we select a diaphragm of the proper thickness, say 2 mils, and introduce thereby a certain amount of mass, or inductance. This mass behaves just like a coil of wire in an electrical circuit and rolls off the shrill high end. Next, we make our diaphragm compliant by having previously selected a limp material, like polyvinyl chloride, so that we add "capacity" to our equivalent electrical circuit. If we make this selection judiciously, the diaphragm will resonate where we lacked energy, or be very efficient at 200 Hz. By using foam

STEREOPHONES WORK 2 WAYS VELOCITY PRESSURE

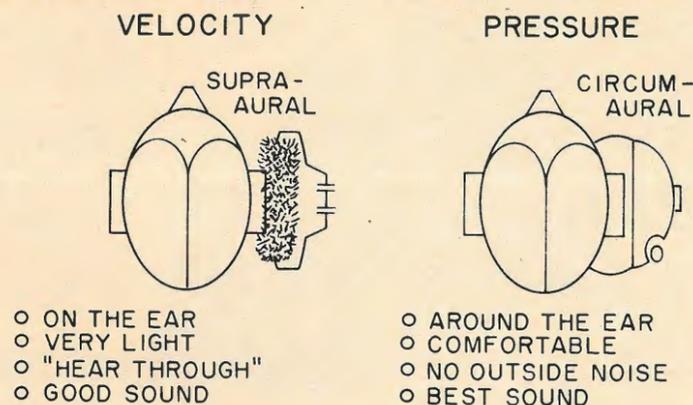


Fig. 4—Comparison of the main features of velocity and pressure type headphones.

HOW THEY WORK— VELOCITY

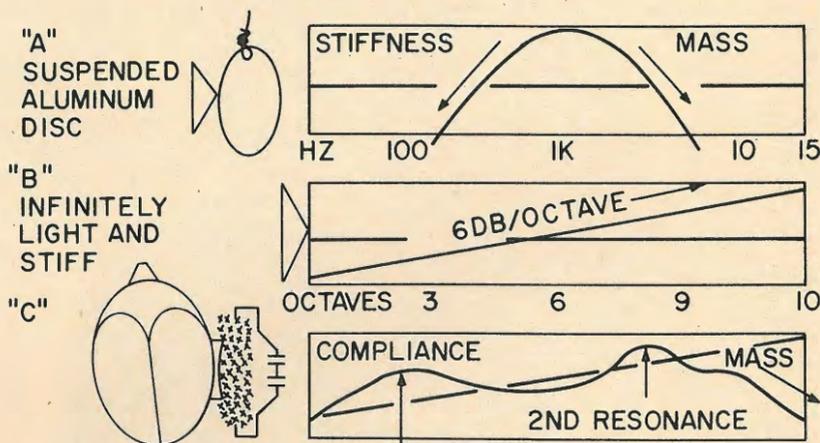


Fig. 5—A, The response of a 2-mil aluminum disc in free space when struck. B, The "ideal" diaphragm is infinitely light and infinitely stiff. C, The mass and compliance of a velocity headphone are chosen so that a large primary resonance occurs at about 200 Hz.

on the frontal area of the earpiece, we introduce resistance which lowers the height of the resonant 200 Hz "hump" and controls it. This foam, or felt, distributes the pressure on the ear and gives comfort, too.

The diameter of the diaphragm determines the frequency of the reflection from the rim back to the center. Gener-

ally this causes a reinforcement in the treble range and is designated as the *second resonance* in the diagram. If a major reflection returns to the center out of phase, a bad cancellation of the signal energy can take place.

At this point in the design, art enters in and science leaves the scene. The

(Continued on page 78)

REAL 4-CHANNEL STEREO IS EXPENSIVE. BUT NOW IT DOESN'T HAVE TO BE VERY EXPENSIVE.



Introducing our expensive, but not very expensive, 4-channel receiver. The Fisher 601.

Last year, Fisher brought out the world's first true 4-channel receiver, the Fisher 701. The price was \$699.95.

Now, you have to understand that a true 4-channel receiver requires nearly twice the electronics of an equally good 2-channel receiver.

And since the 701 was to be the world's first 4-channel receiver, we pulled out all the stops when we designed it. Which resulted in a piece of equipment that was very expensive. Incredibly good, but very expensive.

But now we think it's time to bring out a top-quality 4-channel receiver that more people can afford. One that doesn't cost a lot more than the best 2-channel receivers. So we're introducing the Fisher 601 4-channel AM/FM receiver.

Meet the Fisher 601. \$599.95.

Even though the 601 is not the top of the Fisher 4-channel line, it's a no-compromise piece of equipment.

It's got everything: power, sensitivity, versatility, and wonderfully clean 4-channel sound.

200 watts is a lot of power.

The Fisher 601 has 200 watts of clean power. It's fully capable of driving two sets of speakers—four main, four remote. And it will drive them at concert levels with no sign of strain.

The FM tuner section has 1.8 microvolts sensitivity, which is on a par with the tuners in the finest 2-channel

receivers Fisher makes. You'll get clear reception on stations that non-Fisher tuners pick up as static.

A full complement of controls.

The new 601 receiver is equipped with bass and treble controls, of course. They're of the Baxandall variety, which is a little more expensive than the kind other makers like to use. But they're also better. (They leave the midrange alone while you adjust the bass or treble.)

A muting switch quiets the noise between FM stations. There's a high filter so you can cut out unwanted high frequencies on the front channels, if you choose. There's a balance control, loudness contour and tape monitoring switches for front and rear channels.

Of course, the 601 has controls for mode, selecting speakers, and selecting a sound source. And the front and rear-channel volume controls slide like professional sound-studio faders.

The Fisher 2+2 matrix system. 4 channels out of 2.

Not only does the Fisher 601 give you fantastic sound with true 4-channel program material, it also incorporates a switch to activate a special circuit that lets you create 4 channels out of 2-channel material. The circuit extracts ambiance information from the channels that you otherwise couldn't hear, and feeds it into the two rear channels. This information, which represents the

sum of the reflected signals from the original recording source, enhances the stereo effect. The result is as close as you can get to true 4-channel sound, without actually starting with four separate signals.

So now you can hear your entire library of stereo LP's, tapes, and even FM-stereo broadcasts in 4-channel. And even more important, Fisher's 2+2 matrix system will let you play the various different stereo records and tapes that have been encoded with 4-channel information for playback on a 4-channel system.

That's planned non-obsolescence.

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Send for your copy of The Fisher Handbook, a fact-filled 80-page guide to high fidelity. This full-color reference book also includes complete information on all Fisher stereo components. Enclose 25¢ for handling and postage.

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IC Tone Burst Generator

Part II: How it works and how to build it

Walter G. Jung

HAVING DISCUSSED the general theory behind our IC tone burst generator last month, this month we will get down to specifics; namely a working schematic, details of circuit operation, and a parts list. The complete generator with all its options is an extremely flexible instrument. However there are a number of circuit features which can be deleted if you don't need all the performance of the full-blown version. At any rate, here it is in its entirety—you may carry your own version as far as you desire or your electronic larder permits.

Figure 1 is a functional block diagram which illustrates how the unit is laid out, the input/output signals, and the signal flow path. The input signal is first buffered after entering the instrument, then branched into two paths; one via the synchronizer and one via the switch itself. The processed output of the synchronizer gates the switch ON-OFF to establish a tone burst, and an output amplifier buffers this signal to feed the outside world. An internal power supply feeds the various circuits regulated ± 12 volts and $+5$ volts, also unregulated plus and minus potentials of about 20 volts.

The actual circuitry which accomplishes these functions can be segregated into three main areas, the switch and its associated circuits, the synchronizer and its details, and the power supply. Let's look at them now in that order.

The MC1496G Electronic Switch

The heart of the tone burst electronics is the balanced modulator switch, the MC1496G, which we discussed last month. Figure 2 shows how it is used in this application. The details differ slightly from our general model of last month, but the basic idea is still the same.

Beginning at the input of the instrument (J1) the signal is buffered by IC1, an op-amp connected as a unity gain voltage follower. The input impedance of this connection is very high due to the 100% voltage feedback, so the 47K

resistor R1 serves as the sole determinant of input impedance. The low impedance buffered signal at IC1's output splits into two paths; the route through the switch itself and the synchronizer path (output AA). For the moment we'll

not regard the synchronizer signal and follow the signal flow through the switch.

The signal from IC1 is applied to IC2 by two paths. REa or channel A drives IC2-Q5's emitter on pin 3. Likewise REb or channel B drives IC2-Q6's

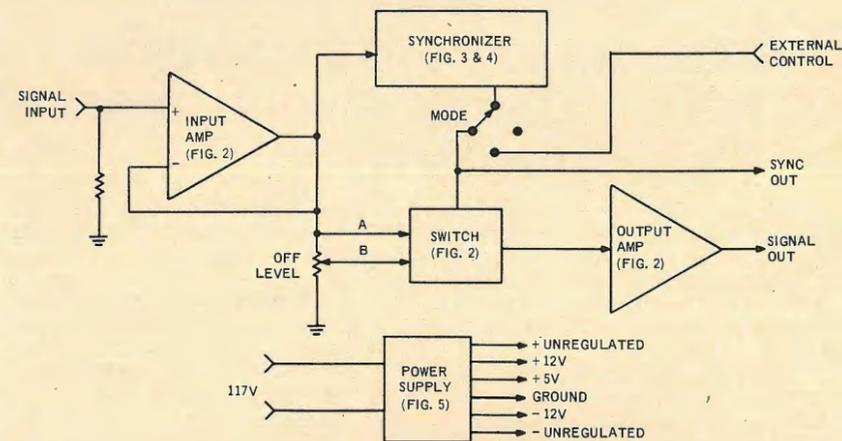


Fig. 1—Block diagram of IC tone burst generator.

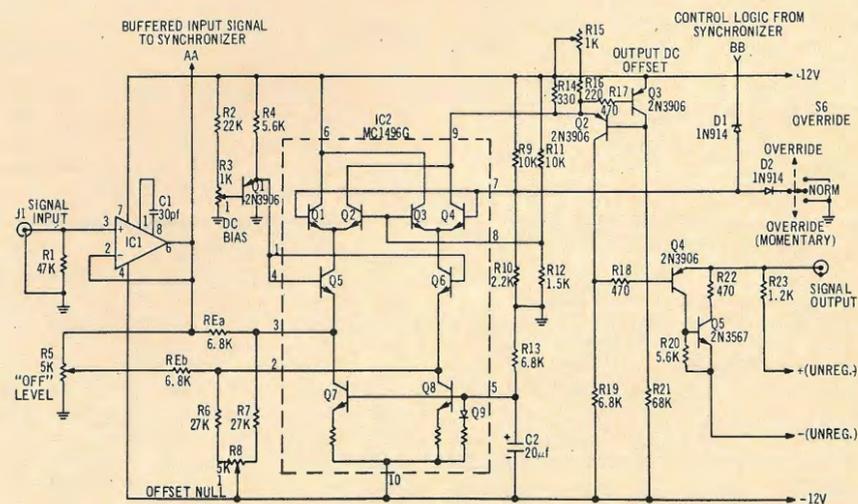


Fig. 2—Schematic diagram of input amp., switch, and output amp.

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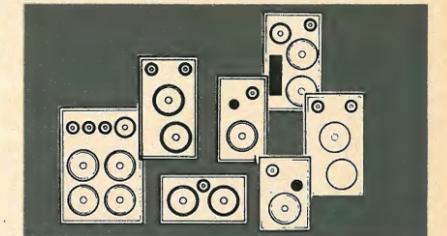
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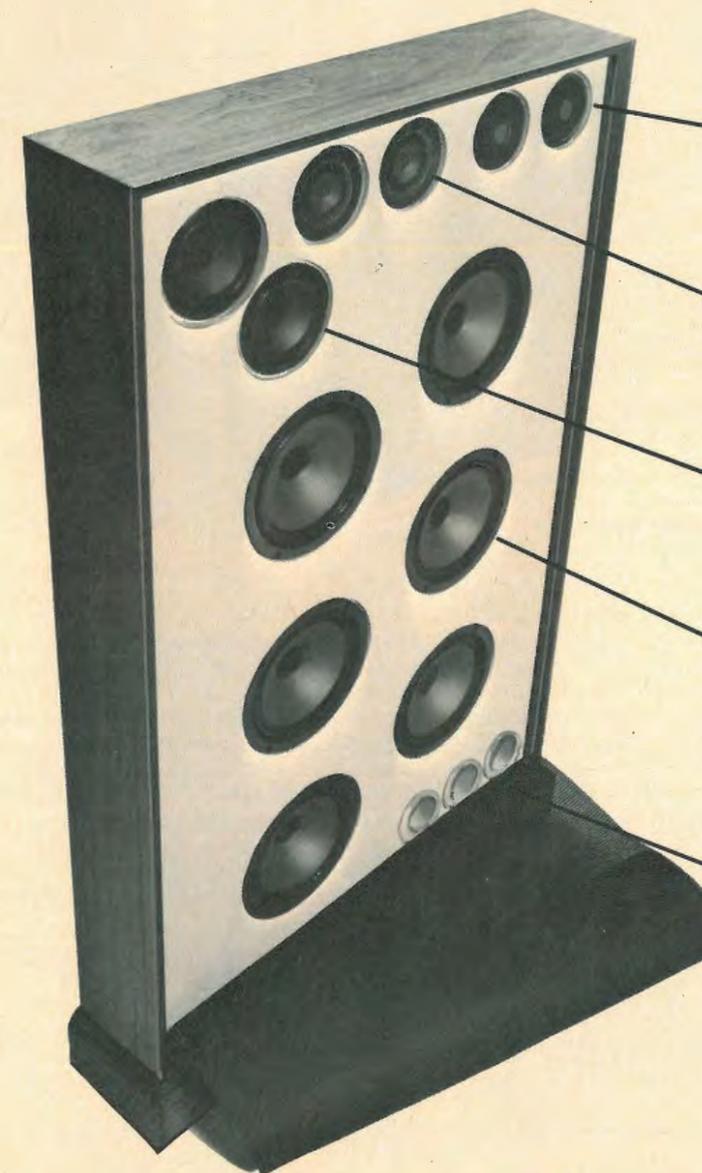
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emitter via pin 2, with the channel B level variable by adjustment of OFF level pot R5. The two switching channels of IC2 operate with IC2-Q5 and Q6 in the common base mode. The connection minimizes crosstalk and maximizes both dynamic range and linearity.

To enable the audio signals to be d.c. coupled through IC2 it is necessary to offset the Vbe of IC2 Q5 and Q6. To accomplish this, a positive d.c. bias is used on their bases (pins 1 and 4) from Q1. This level is variable from R3 and is trimmed so the emitters of IC2-Q5 and Q6 rest at zero volts d.c., thus facilitating d.c. coupling through REa and REb. In addition Q1 provides a very low source impedance, eliminating the common base connection as a possible source of crosstalk.

To eliminate any possible mismatch between the d.c. currents of channels A and B, a differential current balance

network is used in the IC2-Q5 and Q6 emitters. This consists of R6, R7 and trimmer R8. R8 is set up initially to adjust the current offset to zero and needs no further adjustments.

The switching of the IC2-Q5 and Q6 collector currents is just as discussed last month. A fixed d.c. bias is applied on pin 8 from R11-R12 and the pin 7 potential switched to control the state of the switch. In the quiescent state the d.c. bias from R9-R10 holds pin 7 slightly higher than pin 8, which in turn connects the output at pin 9 to source B. When a LOW control logic signal from the synchronizer is applied through D1, pin 7 is pulled low with respect to pin 8; this transfers the switch output to source A. Since in this application only a single output from pin 9 is desired, the opposite side of the switch (pin 6) is a.c. grounded by tying it directly to the +12 V. line.

The signal output from pin 9 does not drive a load resistor directly, but is applied to level shift converter Q2-Q3. This stage translates the high d.c. baseline of pin 9 back down to a zero volt average potential at the top of R19. So we can now have a signal d.c. coupled all the way through the instrument, be switched, and then appear at the output with no d.c. offset, and also no interaction between control signal and output due to RC time constants.

A complementary output buffer, Q4 and Q5, buffers the relatively high impedance of R19 and enables the generator to drive ± 5 volts into 500 ohms at the output jack J4. Current limiting is provided by R23 (positive swing) and R22 (negative swing). Since this output stage is a local d.c. feedback loop in itself (and thus immune to ripple and supply variations), it

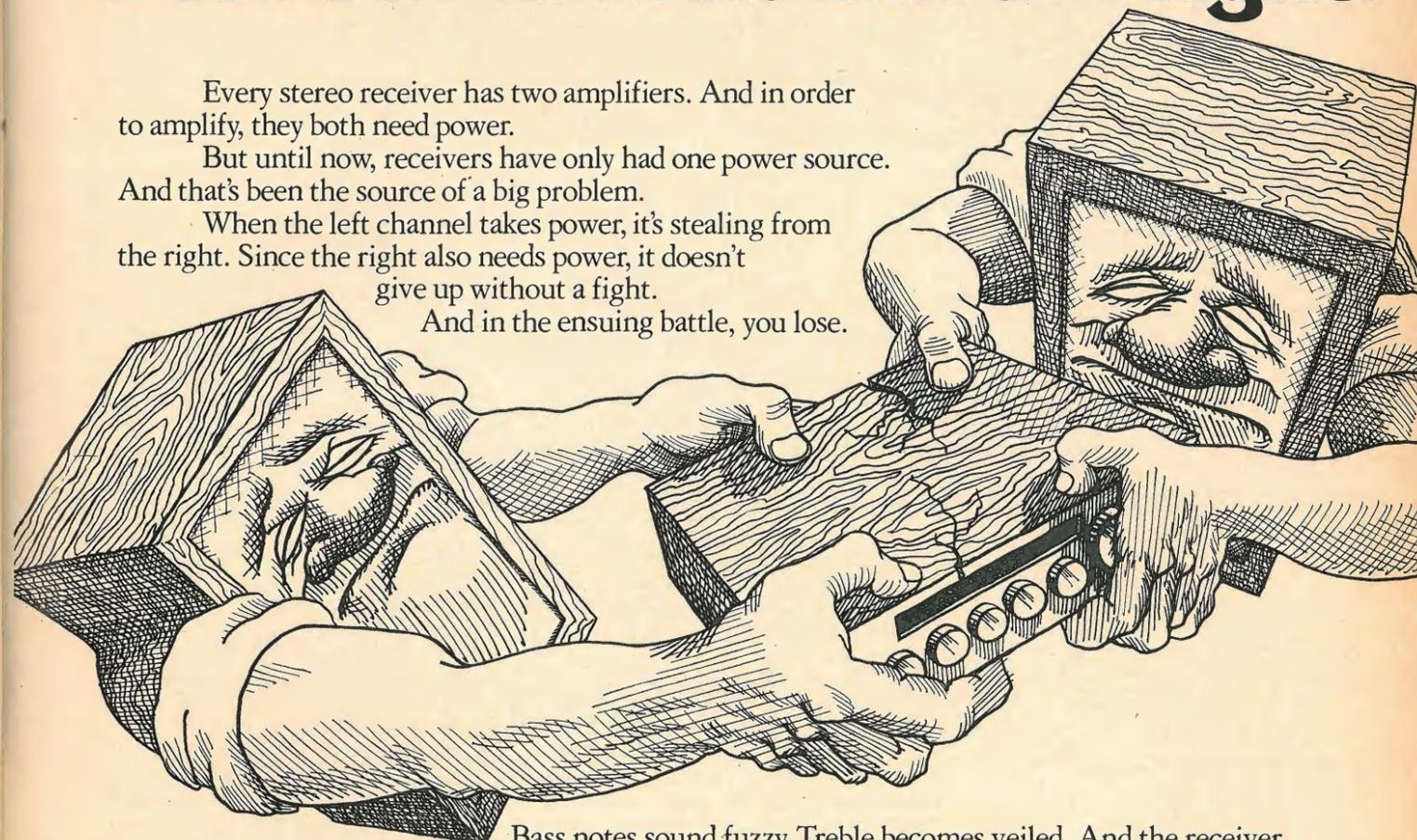
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Every stereo receiver has two amplifiers. And in order to amplify, they both need power.

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As a result, the 930 can handle enormous tone bursts at full volume without straining.

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Instead, we made only those changes which would meaningfully improve performance and reliability.

Not a radical transformation, but a program of rational development.

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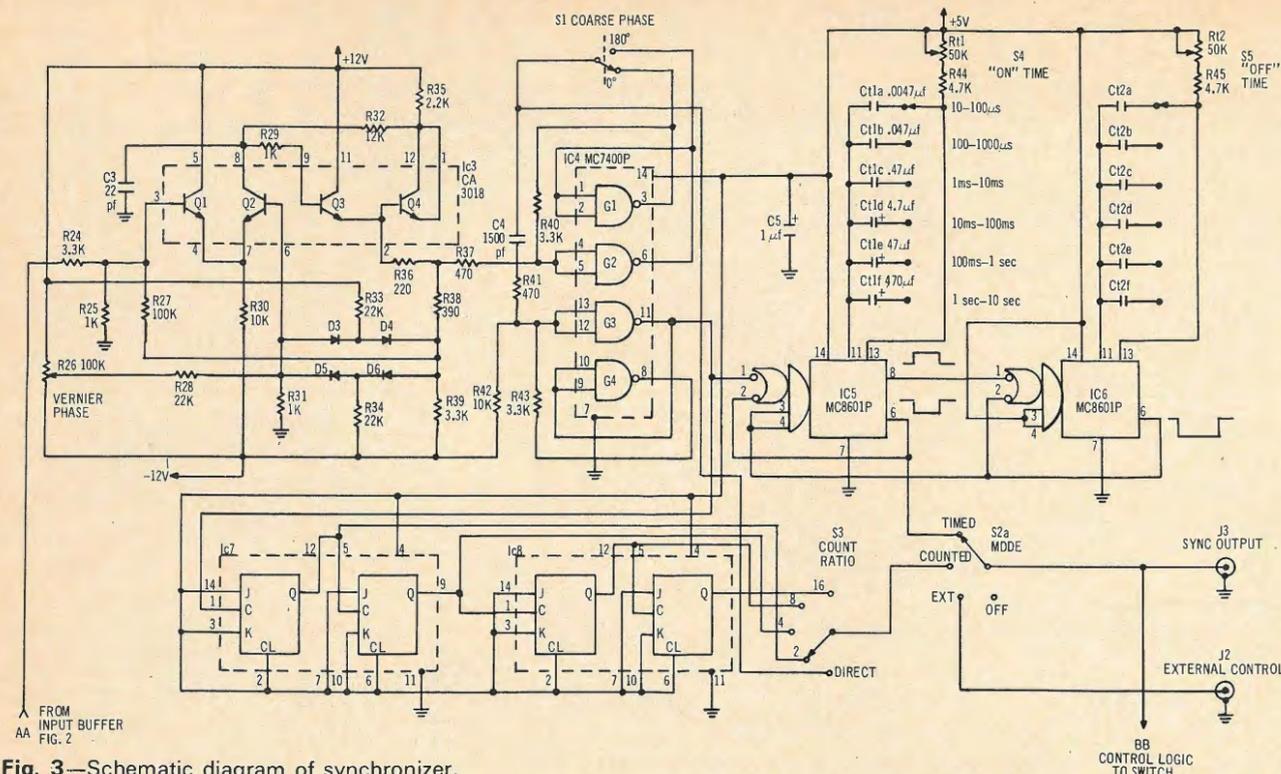


Fig. 3—Schematic diagram of synchronizer.

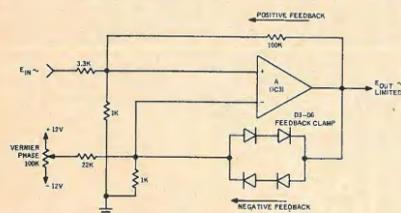


Fig. 4—Functional diagram of IC3 limiter circuit.

is operated from the unregulated + and - lines with no sacrifice in performance.

If we go back to the level shift stage of Q2-Q3 for a moment we can see how this stage adds a measure of versatility to the instrument. The basic requirement of this stage is to cancel the positive voltage offset across the switch IC2. But since this stage is also a local d.c. regulator it can do more than this. By adjusting the d.c. current in Q2 the voltage at the output can be made to rest statically not only at zero volts d.c., but also above and below ground. In either case the signal current from IC2 will linearly be summed atop this d.c. level. So the net result is that by making R15 a front panel control (to adjust Q2's d.c. current) the base line offset can be adjusted to zero or any voltage within the dynamic range of the unit (± 5 volts). This greatly enhances the flexibility of the device as it can be used to "build up" special waveforms to drive logic stages or linear amplifiers using the d.c. component for bias and adding

the signal component by appropriate control settings to the switching stages.

The switching signal from the synchronizer logic stages is applied through one leg of a diode "or" gate D1-D2. With the S6 override switch in its normal position (center), a low signal from the synchronizer implements channel A of the switch though D1. At any time S6 can be used to override this switch control and force the switch on, either momentarily (down) or continuously (up). This allows a fast check of the input, as it will allow any input signal to appear at the output regardless of any other switch settings.

Now let's follow that signal out of AA and see how it is processed by the synchronizer.

The Synchronizer

Last month you'll recall we went into the timing requirements and functions of the synchronizer. The circuitry which accomplishes all of this is Fig. 3. The limiter is IC3, a CA3018 monolithic transistor array connected as a differential input op-amp. IC3 and its associated circuitry is functionally equivalent to Fig. 4. Here the IC is represented by the general amplification symbol, A. The diodes in the negative feedback loop limit the output voltage to \pm two junction drops over a wide range of input signal amplitude due to their logarithmic forward voltage characteristic. You'll also note that there

is a positive feedback path through the 100K resistor. This gives the circuit a 10 mv hysteresis which provides a clean sharp switching action above its threshold. A variable d.c. bias inserted in the negative feedback loop by R26 allows the limiting process to be displaced above and below the zero axis on the slope of the input sine wave. This provides a vernier phase control of ± 90 degrees with a 2 V. p-p input signal. With the phase control set for 0 degrees (maximum sensitivity) this circuit will deliver a constant output with no phase changes over more than 50 dB range on input amplitude variation.

The output of the limiter directly feeds a TTL logic gate Schmitt trigger IC4-G1/IC4-G2 which shapes the limiter output into a fast rise-time rectangular wave with a choice of either 0 or 180 degrees phase relation with respect to the input sine wave. This coarse phasing adjustment is selected by front panel switch S1. The output of this switch feeds IC4-G3/IC4-G4, which is a modified Schmitt circuit (similar to the above) biased in the low input state by R42. When a positive going input appears at C4, the C4-R41 time constant will raise the input to IC4-G3 momentarily and drive the output of IC4-G3 low. A low input to IC4-G4 causes its output to go high which reinforces the original positive transient from C4. As the input pulse decays back towards ground due to the a.c. coupling, IC4-

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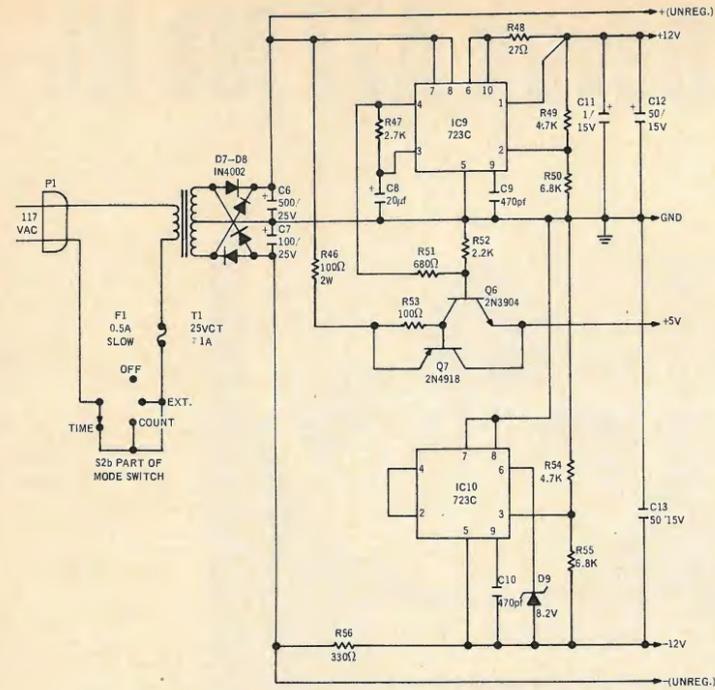
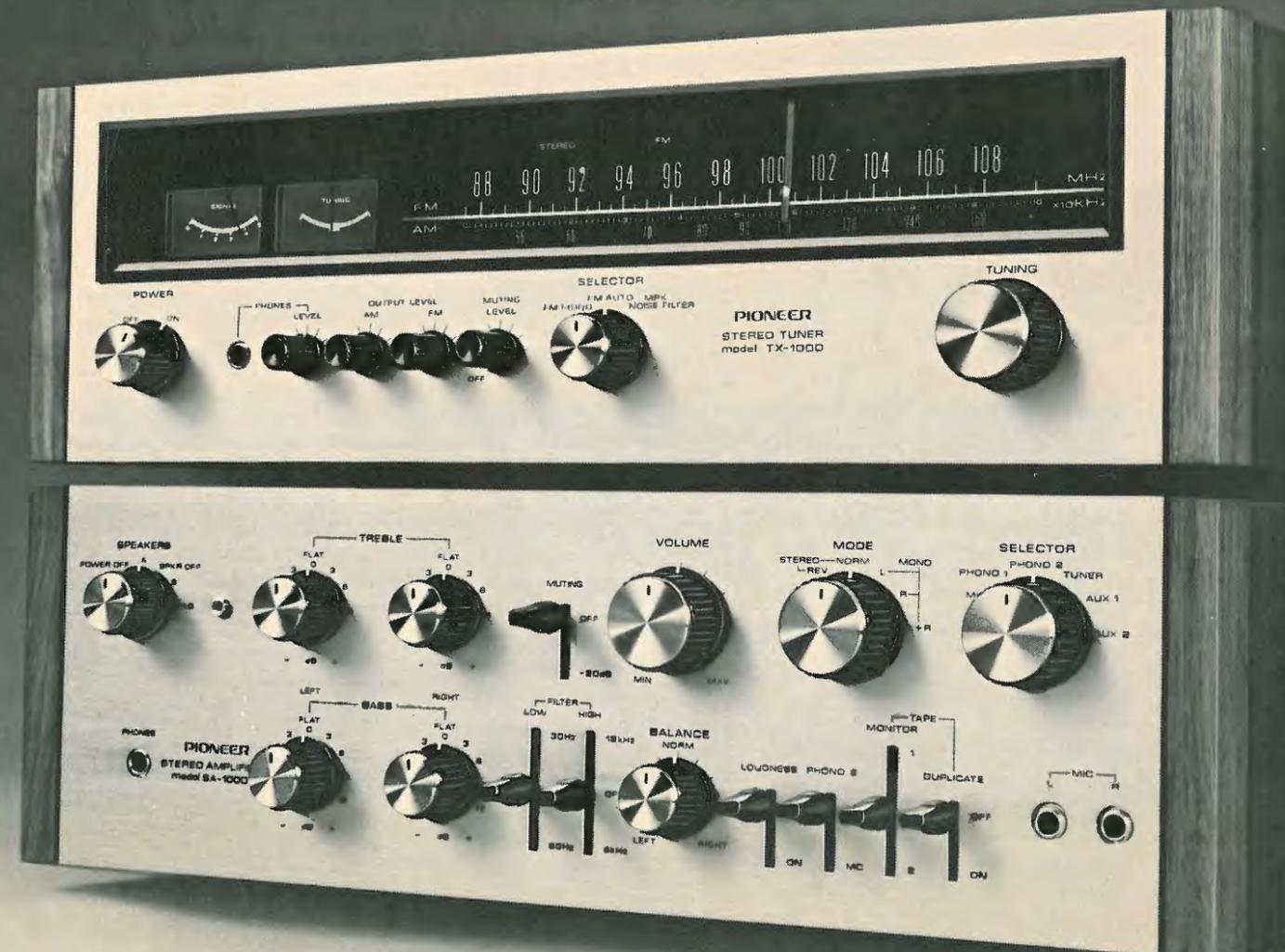


Fig. 5—Power supply.

G3's threshold is reached, and the regenerative action reverses itself, terminating the negative 4 microsecond pulse at IC4-G3's output.

This 4 microsecond pulse serves as a master timing reference for the synchronizer, and clocks both the timing and counting circuits, which will be described next.

The counter circuits of the synchronizer use 2 MC7473P JK flip-flops, IC7 and IC8 connected as a divide-by-16 counter. Output taps are available at division ratios of 2, 4, 8 and 16, allowing any of these count ratios to be selected by COUNT RATIO switch S3. Also available at this switch is a DIRECT position which provides the rectangular wave available at the arm of S1. This position allows fractions of a cycle to be gated. The output of the COUNT RATIO switch feeds MODE switch S2.

The variable ON-OFF timing circuitry of this tone burst generator is comprised of IC5 and IC6 and the switch selected timing components Ct1-Rt1 and Ct2-Rt2. Last month we saw how these two IC monostable multivibrators make up a wide range semi-synchronous timer with independently variable on and off times. Both timers are identical, so a description of one should suffice to illustrate the principle.

The IC used is the MC8601P which is a wide range, directly triggered one-shot multivibrator with both retriggering and gating capability. It generates an output pulse of a duration 0.32 RtCt. As it is used here, all inputs must be HIGH for it to trigger when a negative

pulse is received at pin 1. Before the first trigger pulse occurs, pins 2, 3 and 4 of IC5 are held HIGH by the feedback from IC5 pin 6 and IC6 pin 6. A negative pulse at IC5 pin 1 starts the timing cycle; pin 8 switches HIGH and pin 6 goes LOW. The LOW signal from pin 6 to 2 locks out the input gate and prevents further triggering. The duration of IC5's output pulse length will be determined by the timing components of Ct and Rt, where Ct is the capacitor selected by S4 (ON time) and Rt is the total resistance of Rt1 + R44. The pulse width will be equal to 0.32 RtCt. Rt1 and R44 serve as a vernier time adjustment with slightly over a 10/1 range, and Ct1a-Ct1f provide decade variations to give a total range of time adjustment from 10 microseconds to 10 seconds. The negative output pulse (pin 6) from IC5 serves as the output of the timer and will hold the audio switch ON for the duration of the pulse width.

The negative trailing edge of IC5's positive output pulse (pin 8) triggers IC6 which uses a similar timing circuit, Ct2-Rt2, R45. The output pulse width of IC6 determines the OFF time of the timer, since it will inhibit IC5 from any further triggers for the duration of its negative pulse at pin 6. This negative pulse is fed to IC5 pins 3 and 4 and prevents triggering during the low state of IC6 by locking IC5's input gate OFF.

The net result of this combination is an extremely versatile timing combination with no limitation on relative

ON-OFF ratios. The MC8601P one-shots are stable enough to allow duty ratios of nearly 100% without deviation from the pulse width setting. You can, for instance, gate ON 99 cycles out of 100, turn OFF for 1 cycle and then repeat the ON for the 101st input cycle. Towards the other extreme the possible ratio becomes even more ridiculous—ON for 10 microseconds (1 cycle of 100KC) and OFF for 10 seconds is quite possible! Suffice it to say that there will be no limitation to the flexibility of the available gate times due to the timer circuits.

The output of IC5 pin 6 is also the output of the timer and appears at position 3 of the mode switch S2. The counter output is available at position 2, thus the term COUNTED. An external source connected to J2 may also be selected by using position 1, EXTERNAL. The output of S2 is made available at J3 as a sync signal for scope connections, etc. The signal at this point is the output of the synchronizer, fully processed for direct control of the audio switch. It drives the switch through D1 of the override gate (see Fig. 2).

Power Supply System

The power supply used consists of a full-wave, center-tapped transformer with capacitor input filters (C6 and C7) feeding complementary 12 volt regulator IC9 and IC10. IC9 is a conventional series regulator configuration using the 723's internal pass transistor. The internal reference of +7.15 volts available at pin 4 is used as a reference source for the 5 volt regulator Q6-Q7 after division by R51-R52.

IC10 controls the negative leg in shunt regulator fashion with its terminal voltage set by R54-R55. This IC acts as a "super zener," absorbing any input current variations through R56 due to a.c. ripple or line voltage changes. It also provides an extremely low source impedance for the -12 volt circuits, a condition necessary for good signal-to-noise ratios to be realized in the switch and amplifier circuitry.

Much of the credit for the excellent signal-to-noise ratio of this tone burst generator is due to these high performance IC regulators and careful filtering. Although the circuit is not overly complex, it is none the less able to deliver a stable ± 12 and +5 volts d.c. with ripple less than 500 microvolts. The ± 12 and +5 volt supplies are all short circuit protected. Unregulated taps from the plus and minus input capacitors are also brought off for use in the non-critical stages of the generator.

Construction

The tone burst generator was built into a Bud SC-2130 box with front



Fig. 6—Front panel layout.

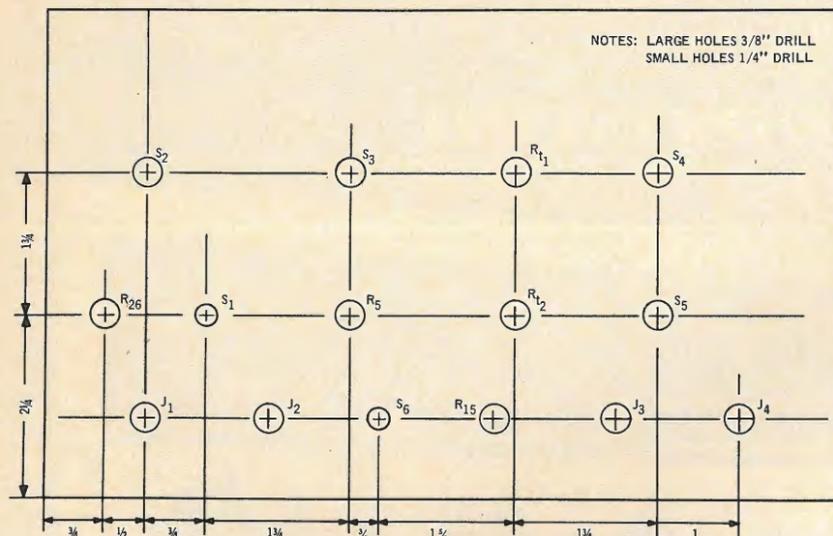


Fig. 7—Front panel layout and drill dimensions.

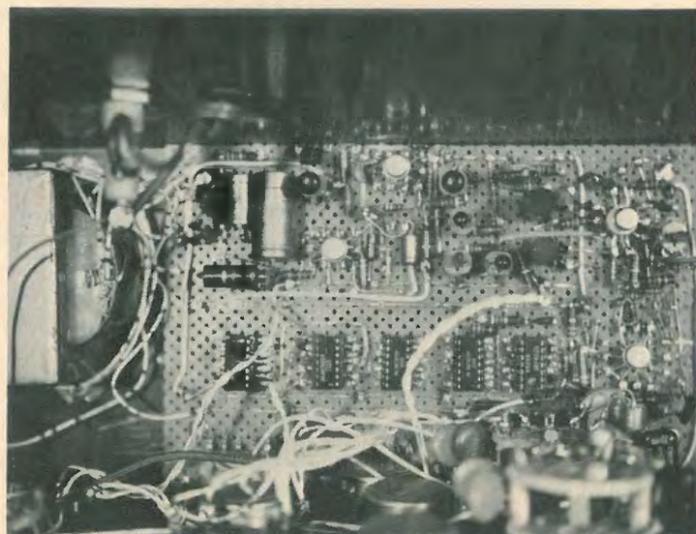


Fig. 8—Internal view.

panel layout as shown in Fig. 6. Should the reader want to duplicate this configuration, a drill template for this layout is included (see Fig. 7). Input/output jacks are arranged J1-J4, left to right. Between J2 and J3 are located the override switch and the offset trim control. The remainder of the controls follow a logical sequence progressing from J1 (input) to J4 (output).

Internal construction is shown in Fig. 8. Here the single 4½ × 6½-in. circuit board and power transformer placement may be noted, as well as the front panel pots and switches.

Perf-board construction was used in the prototype, with the various circuit subsections laid out in segregated areas. Busses for power distribution were used, these may be seen running lengthwise along the board.

The power supply components are in the left rear corner of the board where the secondary leads of T1 connect to the rectifier bridge. The 723 regulators may be seen to the right of the filter caps towards the rear center. Q6 and Q7 are located between the 723's and the capacitors with Q7 near the rear panel. The large resistor in front of the capacitors is R46, which is positioned up and off the board to facilitate heat removal.

In the right rear section are located the MC1496G switch and output amplifier. Trim controls R3 and R8 may be seen in this area also.

The front section of the board is taken up mainly by the synchronizer circuits. The row of dual-inline IC's are the MC8601p's, the MC7473p's and the MC7400p. The CA3018 is at the extreme right of the board. IC1 is towards the left end of the board and up front. In this same area are the connections to the switches S2, S3, S4 and S5.

The timing capacitors Ct1 a-f and Ct2 a-f are mounted on the switches S4 and S5 with R44 and R45 connected directly between Rt1-S4 and Rt2-S5.

One fact of life which should be pointed out concerning the timing capacitors is the lack of precision tolerances available in reasonably priced instrument such as this. The longer periods where tantalum electrolytics are used may not be exact because of the large tolerances of the capacitors. The values are chosen slightly towards the "low" side to allow padding if necessary with additional small value capacitors. In view of the desired low overall cost this was felt to be a reasonable approach.

Options

At this point we have discussed the entire circuit and the parts list describes the components necessary to build the entire circuit. But, as it was pointed out

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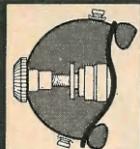
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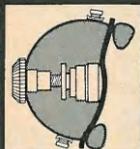
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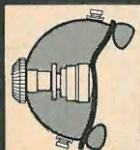
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in the opening paragraph, you may not want to build in all the features. An obvious breakpoint might be to leave out the counter circuits and use only the timer circuits. After all, any duty cycle provided by the counter circuit can be duplicated by the timer with appropriate control adjustment, and the counter may be regarded as a luxury by some. Pay your money and take your choice.

Another area of possible savings are the longer periods of the timer. If you do not foresee the use for a 10 second gating interval, you can dispense with

Ct1f and Ct2f (and save considerable change).

Armed with the above data you are now ready to start rolling on your own IC tone burst generator. A number of IC sources are listed on the parts list, and there should be no problem obtaining devices from the supplies listed. All of the parts are standard.

Next we'll run through a checkout and calibration procedure to aid in proper set up. Then we'll explore some of the many ways you can use a device like this.

(To be continued)

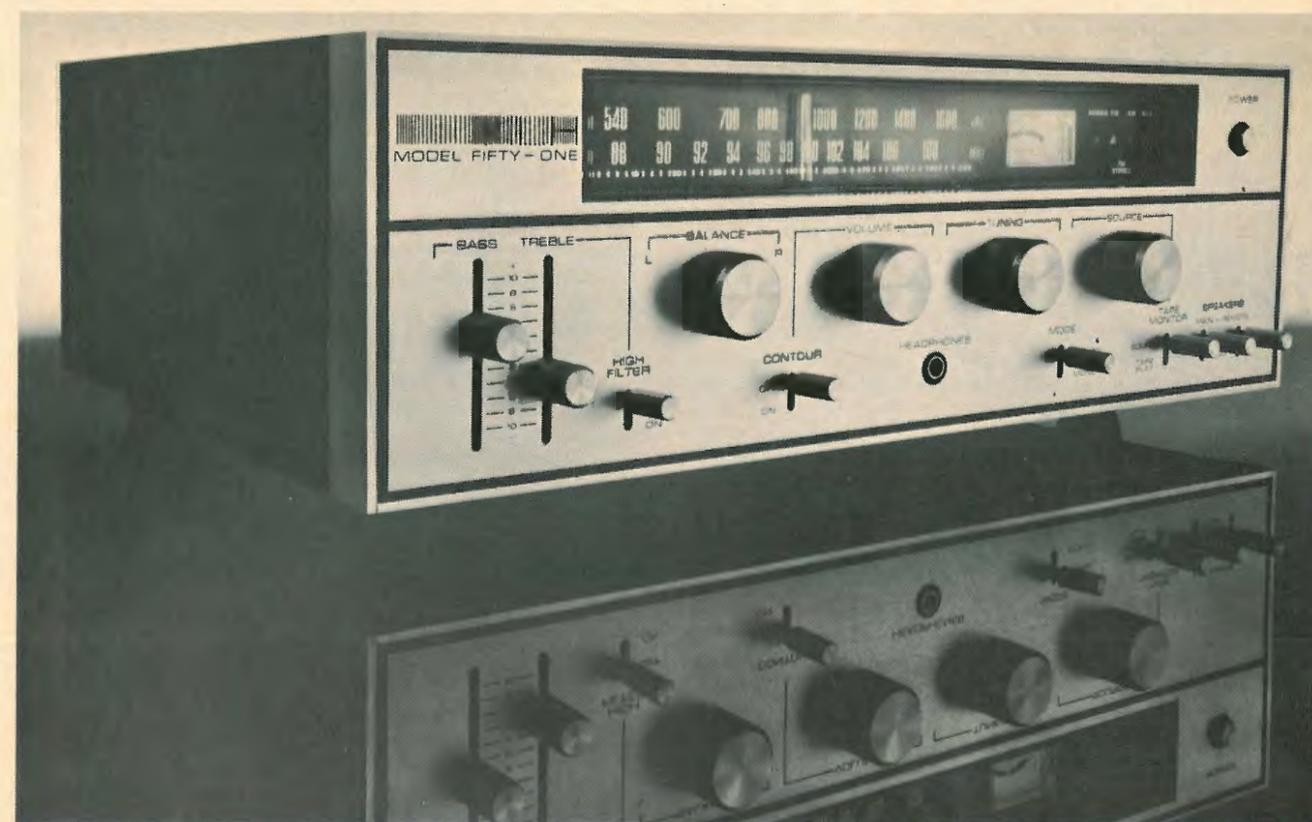
Parts List (Continued on page 81)

Resistors			
Ref. Designation	Description	Part Number	Quan.
R1	47k, 1/4w, ±10%		1
R2, R28, R33, R34	2k, 1/4w, ±1%		4
R3	1k, PC type trimmer	CTS X201R102B	1
R4, R20	5.6k, 1/4w, ±10%		2
R5	5k pot, 2W, linear	Ohmite CMU5021	1
R6, R7	27k, 1/4w, ±10%		2
R8	5k, PC type trimmer	CTS X201R502B	1
R9, R11, R30, R42	10k, 1/4w, ±10%		4
R10, R35, R52	2.2k, 1/4w, ±10%		3
R12	1.5k, 1/4w, ±10%		1
R13, R19, REa, REb, R50, R55	6.8k, 1/4w, ±5%		6
R14	330, 1/4w, ±10%		1
R15	1k pot, 2w, linear	Ohmite CMU1021	1
R16, R36	220, 1/4w, ±10%		2
R17, R18, R37, R41	470, 1/4w, ±10%		4
R21	68k, 1/4w, ±10%		1
R22	470, 1/2w, ±10%		1
R23	1.2k, 1/2w, ±10%		1
R24, R39, R40, R43	3.3k, 1/4w, ±10%		4
R25, R29, R31	1k, 1/4w, ±10%		3
R26	100k pot, 2w, linear	Ohmite CMU1041	1
R27	100k, 1/4w, ±10%		1
R32	12k, 1/4w, ±10%		1
R38	390, 1/4w, ±10%		1
R44, R45, R49, R54	4.7k, 1/4w, ±5%		4
Rt1, Rt2	50k pot, 2w, linear	Ohmite CMU5031	2
R46	100, 2w, ±10%		1
R47	2.7k, 1/4w, ±10%		1
R48	27, 1/4w, ±10%		1
R51	680, 1/4w, ±10%		1
R53	100, 1/4w, ±10%		1
R56	330, 1/2w, ±10%		1

Switches			
Ref. Designation	Description	Part Number	Quan.
S1	Toggle, SPDT miniature (on-none-on)	Alco MST-105D C&K 7101	1
S2	Rotary, double section, 3 positions (+ off)	Mallory 1323L	1
S3	Rotary, single section, 5 positions	Mallory 3215J	1
S4, S5	Rotary, double section, 6 positions	Centralab 1410	2
S6	Toggle SPDT, miniature (on-off-momentary on)	Alco MST-105H C&K 7107	1

(Continued on page 81)

For \$239.95* we think you deserve something more than just another stereo receiver. KLH introduces something more.



Most stereo receivers that cost between \$200 and \$250 don't sound half bad. Some even look kind of nice, if not exactly sexy. And they usually work more times than not. Perhaps they can best be described as predictably adequate.

To us, that doesn't sound too thrilling.

We figure a couple of hundred dollars or so entitles you to something more. Something like our new Model Fifty-One AM/FM Stereo Receiver. For one thing, it has big de-

pendable power; it'll drive loudspeakers that leave lesser instruments gasping. It looks more expensive than similarly priced stereo receivers. And it feels more expensive too. Each knob, switch and sliding control gives you a real sense of authority. Stations literally lock in when you turn the dial. The controls are crisp and flawless. No mushiness here. Also, both the AM and FM sections will pull in stations you didn't even know were on the dial. But most important, the Fifty-

One has the overall quality that most people expect from KLH. And you get it all for just \$239.95† (including walnut-grain enclosure).

Make sure you see and hear the Fifty-One soon. It's at your KLH dealer now. You'll recognize it immediately; it's the sexy one that sounds great.

For more information on the Model Fifty-One, write to KLH Research and Development, 30 Cross St., Cambridge, Mass. 02139. Or visit your KLH dealer.



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*Suggested east coast retail price; suggested retail price in the south and in the west \$249.95
†A trademark of The Singer Company

Improved Headphone Listening

Build a stereo-crossfeed circuit

Siegfried Linkwitz*

RECENT REVIEWS of stereo headphones and introductions of new models by various manufacturers point towards an increasing interest in headphone listening.

Offering the possibility of listening in complete privacy and at volume levels which might be intolerable otherwise, stereo headphones in addition can provide a fidelity of sound reproduction equal if not superior to the very best loudspeakers, yet at considerably lower cost. When buying a pair of headphones, it should be kept in mind that the published frequency curves are measured with an "artificial ear," a fixture which tries to approximate the geometrics of a true ear, and that the measured curves may differ considerably from the sound pressure that is actually perceived by the listener. So the best advice is to listen to a variety of headphones, just as one would do when selecting loudspeakers.

There are some problems with headphone listening which might not be immediately apparent:

1. Headphones can become very uncomfortable after wearing them for more than a half hour, because they might be too heavy or clamp the ears too strongly.

2. Some headphones, due to their acoustical design, require an airtight seal between the ear and the reproducer in order to avoid low frequency loss. This provides a large amount of isolation between the listener and his surroundings and, while this might be very desirable in a monitoring situation or while

listening in a noisy environment, it can also put great strains on a normal family life because the listener, even though present, cannot be talked to.

3. Finally there is a problem due to the unnatural spaciousness of the sound reproduction and the complete separation between channels which does not correspond to our normal listening experience. Thus this "super stereo" effect, while very impressive at first, becomes very tiring after a while.

In summary, four factors are required for satisfying listening with stereo headphones:

1. A flat or at least smooth frequency response;
2. A physically comfortable design of the headphones;
3. An amount of isolation appropriate to the living environment, and
4. A means of reducing the channel separation to a natural level.

The first three requirements can be met by choosing the right headphones, but a little help is hereby offered to bring the recorded sound back to its natural spaciousness, even though the problem has been long recognized and described(*).

Therefore the circuit shown in Fig. 1 was developed for addition to any stereo amplifier, either as a separate unit to be connected to the second speaker terminals of most amplifiers or as a modification of the standard headphone output circuitry.

*Hewlett-Packard Co.

*Larson, Eargle, *AUDIO*, Nov., 1962; Bauer, *JAES*, April, 1961, Oct., 1965.

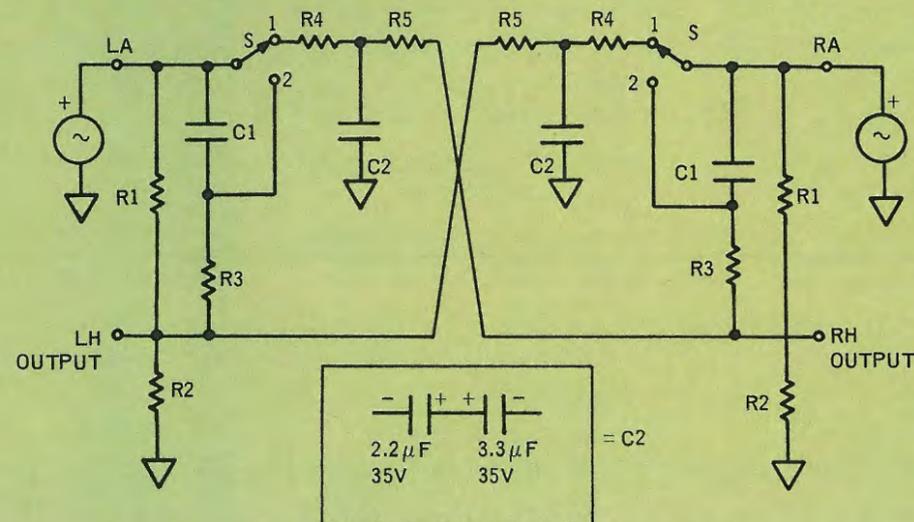


Fig. 1—Crossfeed network.

This circuit provides crossfeed between the outputs of the right and left amplifier channels in such a way that the separation between the channels is reduced to 3 dB for frequencies below 700 Hz and increases above 700 Hz. (See Fig. 2.) The reason for this is that at low frequencies with a correspondingly long wavelength (e.g. 1.6 feet at 700 Hz) the sound pressure will be in phase at each ear in a natural listening situation, because the distance between ears becomes less than one half of a wavelength.

However, it is assumed that there can be a difference in intensity at each ear, so the channel separation is maintained at 3 dB.

The two resistors, R1 and R2, in Fig. 1 form an attenuator between the amplifier LA and the headphone output LH. Crossfeed between outputs is obtained through the lowpass filter R4, C2.

The crossfeed signal adds to the direct signal when they are in phase and thus the headphone output voltage will increase for low frequencies. In order to partially compensate for this, the direct signal is boosted 2 dB for frequencies above 700 Hz by the highpass R3, C1.

Only partial compensation is attempted since it cannot be expected that all low frequency signals are in phase and will add on contemporary stereo records.

The DPDT switch, S, will in position 2 turn off the crossfeed and the high frequency boost, restoring the standard headphone outputs. The purpose of this switch is mainly to demonstrate the effectiveness of the crossfeed circuit and otherwise could well be left out.

Several observations can be made about using the crossfeed network:

1. If, for example, a radio announcer speaks only on the left channel, he appears to have moved his position forward toward the center by about a 40 degree angle. The feeling of being deaf in the right ear is gone.

2. In some cases there appears to be a loss in low frequencies. This is due to the cancellation of the unrealistic out-of-phase signals. The same effect makes vertical rumble from records

inaudible, since it produces out-of-phase signals. The realism of reproduction is greatly enhanced by the corresponding improvement in the signal-to-noise ratio.

3. Finally, the main objective for the circuit, the appropriate reduction of channel separation has been very satisfactorily achieved. Rather than sitting in the midst of an orchestra with the violin against one ear and the drum against the other, the instruments now seem to have moved forward and away from the listener and a sense of depth in the forward direction is added. This is particularly felt on recordings which try to maintain the natural balance between solo instruments and the whole orchestra. It becomes easy to get a sense of the layout of the orchestra and the location of individual instruments. At the same time the positioning of the recording microphone becomes much more apparent. The crossfeed network reduces the sound space to known and familiar dimensions.

In conclusion it can be said that this simple and inexpensive circuit will, in combination with high quality headphones, improve the fidelity of reproduction to a degree which few loudspeakers can match. This hope is that hi-fi enthusiasts will find it easy enough to add the crossfeed to their system for greater fidelity and enjoyment.

AE

Parts List

R1	470 ohms, 1 watt
R2	100 ohms, 0.25 watt
R3	1k ohms, 0.25 watt
R4	330 ohms, 1 watt
R5	330 ohms, 0.25 watt
S	DPDT switch
C1	0.22 μF, 35 volts
C2	1.3 μF, 35 volts
C2 consists of 2.2 μF and 3.3 μF capacitors in series, positive ends together.	

Two of each required except for the switch, where only one is needed.

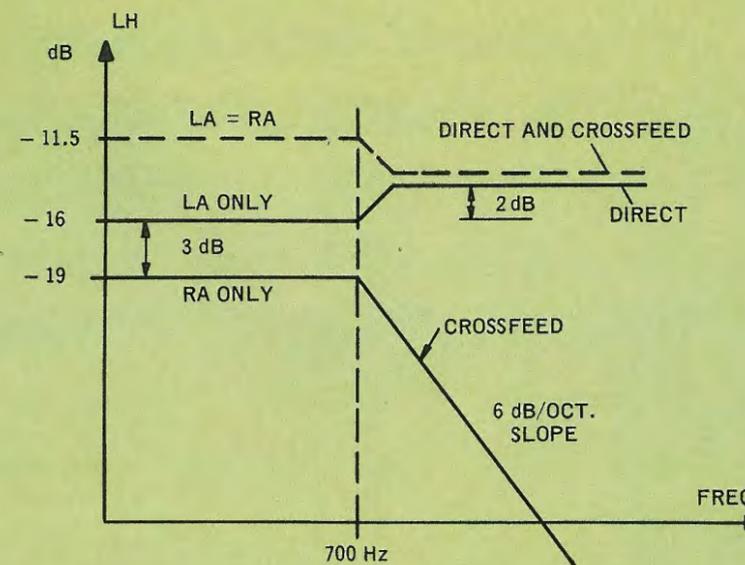


Fig. 2—Frequency response. The left channel headphone output (LH) is a function of the left and right channel amplifier outputs (LA, RA) using the circuit shown in Fig. 1.



Hearing the sounds of Christmas. A group of deaf children, all of pre-school age, listen to sounds familiar to everyone else in this series of pictures by John G. Kenney, award-winning photographer for Elyria, Ohio *Tri-Graphic-Telegram*.

These pictures won Kenney a first place, best picture series in the Inland Daily Press Assn. contest. He used a Nikon F with a 28mm lens.

STEREO HEADPHONES



Akai ASE 22



Bogen EP-10



Beyer DT-900



AKG K-180

MANUFACTURER	MODEL	Type	Frequency Response, Hz		Impedance, Ohms	Sensitivity mW input for 100 dBm out	Max. input, mW	Distortion, %	Cord Length, Ft.		Price	SPECIAL FEATURES
			±1 dB						Weight, Oz.			
AKAI	ASE-95	Dyn.	25-15K	8	—	—	—	6	16			
	ASE-20	Dyn.	20-18K	8	—	—	—	6	16			
	ASE-22	Dyn.	20-20K	8	1	500	0.1 (1 mW)	6	20			
AKG (NORELCO)	K-120	Dyn.	20-20K	600	1 mW/ 125 dB	20	1.0	9	12	22.50		
	K-60	Dyn.	20-20K	600	1 mW/ 125 dB	20	1.0	9	11	39.50		
	K-180	Dyn.	20-20K	600	1 mW/ 125 dB	20	1.0	9	17	69.00		Subjectively controllable sound.
ALLIED RADIO SHACK	PRO-1	Dyn.	10-24K	8	—	—	—	10	16	49.95		Volume controls in each earcup.
	Nova-Pro	Dyn.	20-20K	4-16	—	—	—	10	16	29.95		Volume controls in each earcup.
	Custom Pro	Dyn.	20-20K	4-16	—	—	—	10	16	22.95		Bassport design.
	Air-cushioned	Dyn.	40-15K	4-16	—	—	—	10	16	12.95		
ASTROCOM		Dyn.	30-18K	8	1 mW	500	1.0	6	15	39.95		Headpad, earcushions, and cord readily replaceable.
AUDIOTEX DIV., GC ELECTRONICS	30-5206	Dyn.	40-50K	8	—	60,000	1	12	—	59.95		
BELL & HOWELL	87797	Dyn.	20-12K	8	1 mW	200	1.0	8	10	19.95		
	87796	Dyn.	20-18K	8	1 mW	500	1.0	10	8	9.95		Coiled Cord.
BEYER (GOTHAM)	DT485	Dyn.	16-18K	5	0.063	200	0.3	10	17	102.50		
BEYER (REVOX)	DT900	Dyn.	30-18K	5-2000	*	200	0.5	6½	9	29.95		*At 1 mW = 114 dB over 2 x 10 ⁻⁴ μbar.
	DT100	Dyn.	30-18K	5-2000	*	200	0.2	7	9	57.50		*110 dB/mW over 2 x 10 ⁻⁴ μbar. at 400 Hz.
	DT480	Dyn.	20-18K	25 or 200	*	200	0.1	7	16	75.00		*155 dB/mW over 2 x 10 ⁻⁴ μbar. at 400 Hz.
BOGEN	EP-10	Dyn.	20-15K ±5	8	1	200	0.5	9	20	29.95		Soft, washable vinyl ear cushions.
BSR McDONALD	EP-1	Dyn.	20-20K	8	—	—	—	10	5	34.95		
CALECTRO DIV., GC ELECTRONICS	Q4-132	Dyn.	20-20K	8	—	3000	—	6.5	—	17.95		Individual Volume Controls.

STEREO HEADPHONES



Pioneer SE-L20



Koss Pro-4AA



Clark/100



Maximus HP-2

MANUFACTURER	MODEL	Type	Frequency Response, Hz ±1 dB	Impedance, Ohms	Sensitivity, mW Input for 100 dbm out	Maximum Input, mW	Distortion, %	Cord Length, Ft.	Weight, Oz.	Price	SPECIAL FEATURES
DAVID CLARK	100A	Dyn.	20-18K ±6	17	105	1000	1.2	9	16	50.00	Also available in 300 and 600 ohms.
	200	Dyn.	30-16K	8	100	500	1.5	9	16	29.00	
	250	Dyn.	30-16K	8	100	500	1.5	9	16	34.00	With vol. control.
	300	Dyn.	40-14K	8	100	500	2.0	9	16	21.00	
FISHER	HP-100	Dyn.	18-22K	50	2.0	700	0.1	8	10	49.95	Foam cushions; slot-loaded, reverse-driven microphone elements.
	HP-70	Dyn.	30-18K	16	2.5	500	0.1	8	12	29.95	Foam-filled cushions; easy adjust headband; coiled cord.
HITACHI	HD-66	Dyn.	20-18K	8	-	500	1.0	6½	12½	23.95	
KLH	80	Dyn.	20-20K ±4	600	0.06	1.66	<1.0	10	11½	49.95	Coiled cord; headband conforms to head; can be used w. any amp impd. 0 to 600Ω.
KOSS	PRO/4AA	Dyn.	10-20K ±12	2.0	150 @ 1 kHz	-	<0.5 @ 110 dB SPL	10	19	60.00	Prof. use, oversize diaphragm compliance ring, 1 in. voice coil
	KO/727B	Dyn.	10-18K ±12	3.2	5 @ 1 kHz	-	-	10	19	34.95	¾ in. diameter driver units.
	KRD/711	Dyn.	10-17K ±12	300	35 @ 1 kHz	-	-	10	12	29.95	Lightweight; flexible, high strength polypropylene headband; PVC earcushions.
	ESP/9	Electrostatic	10-19K ±5	8-50	3000 @ 1 kHz	-	<0.2 @ 110 dB SPL	6	19	150.00	Wide-range response, for critical monitoring, delivers all 10 audible octaves.
LAFAYETTE	F2001	Elect.	5-35K	8-16	-	-	-	10	21	59.95	4½ x 5 in. earcushions; comes w. self-energizer.
	F1000	Dyn.	20-20K	8	-	-	-	6	15	39.95	Two 2½-in., 2-way woofer-tweeters; left and right vol. controls.
	F990	Dyn.	20-20K	8	-	-	-	6½	14	29.95	Two 3½-in. speakers.
	SP55	Dyn.	30-15K	8	-	-	-	5	15	11.95	Two 2½-in. speakers; air-cushioned headband.
MAXIMUS	HP-1	Dyn.	25-18K	8	1.0	1000	1.0	10	12	12.95	Adjust. padded headbands; vinyl-covered foam earcushions.
	HP-2	Dyn.	25-18K	8	1.0	1000	1.0	10	13	19.95	Adjust. padded headbands; vinyl-covered foam earcushions; vol. cont. on each earpiece.
	HP-3	Dyn.	18-20K	8	1.0	1000	1.0	10	15	29.95	Adjust. headband; vinyl-leather foam earcushions; indiv. vol. cont.; stereo-mono selector.
MB (STANFORD)	K 600	Dyn.	16-20K	16	0.2	400	0.3	8	21	69.95	
	K 66	Dyn.	20-17K	16	0.15	100	-	8	6	21.95	
PIONEER	SE-50	Dyn.	20-20K	4-16	-	500	-	16	24	49.95	Vol. and treble controls; w. storage box, padded band and cups.
	SE-30A	Dyn.	20-20K	4-16	-	500	-	8	14	34.95	Padded band and cups; w. storage box.
	SE-L20	Open Air	20-20K	4-16	-	500	-	-	-	39.95	Open air type.
	SE-L40	Open Air	20-20K	4-16	-	500	-	-	-	29.95	Open air type.
PML (ERCONA)	D42 Deluxe	Dyn.	30-20 kHz	200	0.3	-	2.0	6	9½	29.95	
	RDF224	Dyn.	20-18 kHz	8	1.0	100	1	8	12	24.95	
ROLECOR	Rotel RH-700	Dyn.	20-20K	8-16	-	500	1.0	12	12	25.00	
SANSUI	SS10	Dyn.	20-20K	8	-	500	-	9½	22	29.95	Sep. vol. conts.; coiled main cord plus extension cord with Y adaptor for 2 headset connection.
	SS2	Dyn.	20-18K	8	-	1000	1.0	6	12½	19.95	

STEREO HEADPHONES



Sony DR-6A



Telex Studio I



Superex ST-PRO B-V

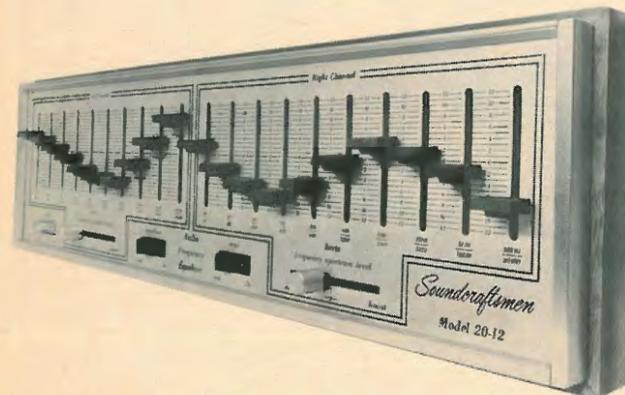


Stanton Isophase Mark III

MANUFACTURER	MODEL	Type	Frequency Response, Hz ±1 dB	Impedance, Ohms	Sensitivity, mW Input for 100 dbm out	Maximum Input, mW	Distortion, %	Cord Length, Ft.	Weight, Oz.	Price	SPECIAL FEATURES
SENNHEISER	HD414	Dyn.	20-20K	2K	1 mW for 102 dB	-	1 at 122 dB	10	5	33.95	Detachable.
SHARPE	770	Dyn.	20-20K ±3	4-16	0.82	1K	0.6	14	19	100.00	Response tracings; vol. controls; fused; coiled cord; liquid-filled earcushions.
	660	Dyn.	20-20K ±3	11	0.82	1K	0.6	14	19	60.00	Fused; coiled cord; liquid-filled earcushions.
	Mk II	Dyn.	30-15K ±3	8	0.23	2K	0.3	14	18	45.00	Coiled cord; liquid filled earcushions.
	10B	Dyn.	30-14K ±3	8	0.28	2K	0.4	14	18	39.95	Coiled cord; liquid-filled earcushions.
	7	Dyn.	15-20K ±5	8	0.34	1K	0.9	14	7	19.95	Liquid-filled earcushions.
SONY/SUPERSCOPE	DR-7A	Dyn.	25-18K	8	-	500	-	10	8	14.95	Coil cable.
	DR-6A	Dyn.	20-20K	8	-	110	.5	6	13.5	29.95	
STANTON	5700	Electrostatic	20-20 kHz ±6 dB	4, 8, 16	2v/100 dB SPL	5000	>1%	11	15	159.95	Level-sensitive circuit passes 130 dB peaks, but disconnects when level exceeds 110 dB for extended periods. Reset buttons restore operation.
	5750	Dyn.	30-18 kHz ±6 dB	12	.11v/100 dB SPL	500	>1%	10	28	59.95	Two-way, separate dynamic woofer and tweeter with individual L-C crossover.
SUPEREX	PEP-71	Elec.	10-22K	4-16	5 W.	20 W.	0.02	15	12	99.00	Separate console cont. w. vol. conts.; Polarization self-energized or 1 mV a.c.; can accept two phones.
	ST-PRO B-V	Dyn.	16-22K	4-16	-	2000	0.05	15	23	59.95	Dynamic woofer; ceramic tweeter; replaceable cushions. Z, 600, 2000, or 15K avail.
	ST-PRO B	Dyn.	16-22K	4-16	-	2000	0.7	15	20	50.00	As above.
	SST	Dyn.	20-20K	4-16	-	2000	0.85	15	18	39.95	Dynamic woofer; ceramic tweeter; vol. and tweeter conts.
	SW-2	Dyn.	40-15K	4-16	-	2000	0.85	15	15	24.95	
TEAC	ST-F	Dyn.	30-18K	4-16	-	1000	0.7	15	10	24.95	
	HP-101	Dyn.	18-20K	8	1	500	-	6½	13.7	25.00	Mylar diaphragm; adjustable headband.
TELEX	HP-102	Dyn.	18-20K	10K	1	500	-	6½	13.7	25.00	As above.
	Studio I	Dyn.	20-22K	3-16	105 dB SPL/mW	1000	1.0	25	24	99.95	Slide tone and vol. controls for each channel; surgical silicone earcushions and headband; padded carrying case.
	Studio II	Dyn.	20-22K	3-16	105 dB SPL/mW	1000	1.0	25	24	84.95	Surgical silicone earcushions and headband; padded carrying case.
	Serenata	Dyn.	20-20K	3-16	-	2000	0.5	8	16	59.95	Liquid-filled earcushions; padded carrying case.
Encore	Dyn.	50-18K	4-8	-	5000	1.0	8	11	9.95	Lightweight; adjustable.	

Equipment Profiles

- Soundcraftsman 20-12 equalizer 48
- Heath AR-1500 AM/FM receiver 52
- Rotel RT-320 AM/FM tuner 60



Soundcraftsman 20-12 Equalizer

MANUFACTURER'S SPECIFICATIONS

Range: 12 dB boost and 12 dB cut, each octave. **Frequency response:** +.5 dB from 20 Hz to 20 kHz. **THD:** less than 0.1% at 2 volts. **IM:** Less than 0.1% at 2 volts. **Signal-noise ratio:** Better than 90 dB at 2 volts input. **Input Impedance:** Operable from any source 100 K or less. **Output Impedance:** Operable into 3K ohms or greater. **Master output level:** From -12 dB to +6 dB. **Dimensions:** 5½ by 17¾ by 11 inches. **Price:** \$299.50.

Most audio equalizers intended for domestic use divide the spectrum into 8 or 10 bands, in contrast to elaborate professional units which give up to 24 one-third octave positions. Thus control is not so accurate, neither is it possible to equalize for all conditions with the cheaper and less complex units. Again, no amount of frequency compensation will make a poor loudspeaker sound like a good one but it must be conceded that a simple equalizer can often make quite a dramatic improvement. Rooms with very bad standing waves might well need a one-third octave band correction (some experts favor one-tenth!) but it is surprising what equalizers like the Soundcraftsman can do to help matters. More than this, they can be used to filter and equalize poor program material for taping discs—especially old 78's, they can be used for special effects: in fact the serious tape recordist will find them invaluable.

The unit under evaluation, model 20-12, has separate controls for each channel and is self-powered. In use, it is simply connected between *tape out* and *tape in* sockets of the amplifier or between preamplifier and power amplifier, if separate units are used. The two channels are divided into 10 one-octave

bands and each vertical slider control is calibrated 0 to plus and minus 12 dB—a total swing of 24 dB. The power switch is on the extreme left and under the slide controls is a separate level control for each channel, and a control which allows the equalizer to be switched out of circuit. The remaining switch, to right of center, is for a tape recorder. At the rear are the various input and output sockets plus an a.c. outlet. A look at the inside revealed a nice, workmanlike layout with the power supply board at the rear and the fully screened circuit boards at the front. (See figure 1). Each channel uses 5 transistors and

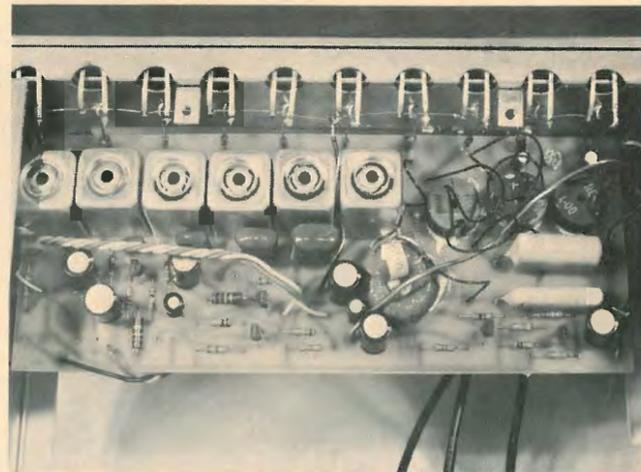
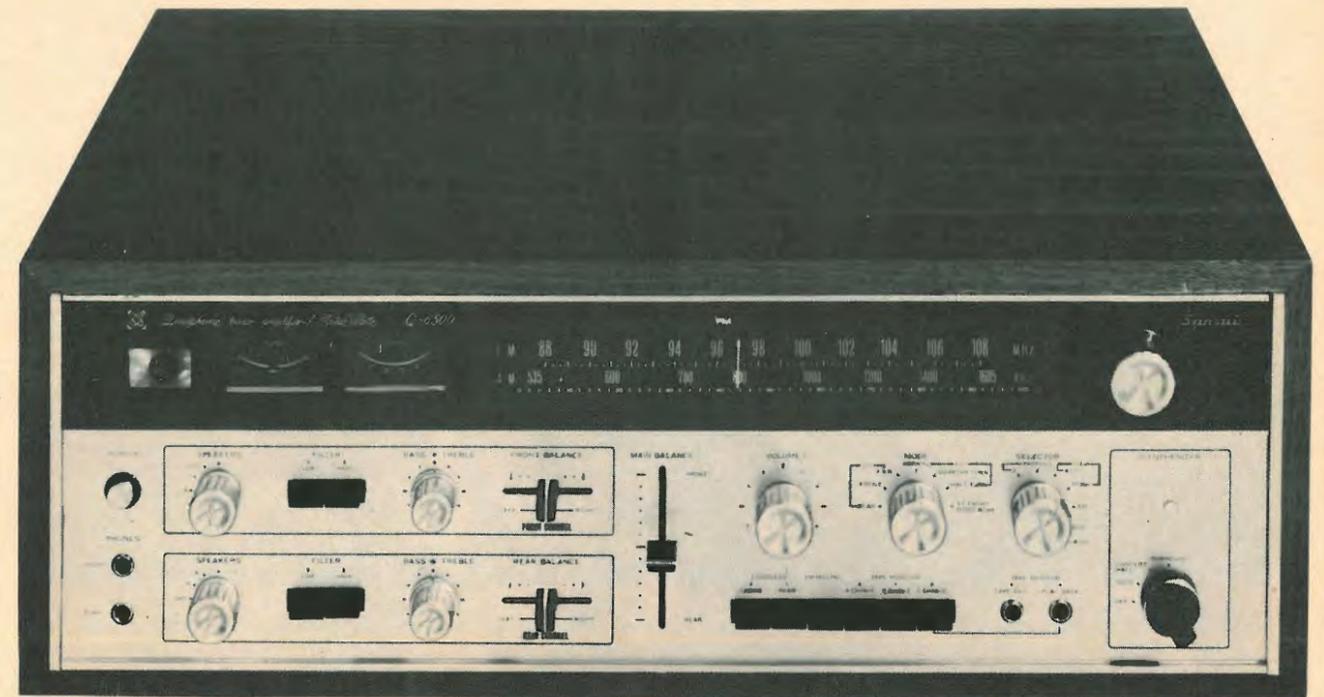


Fig. 1—Showing internal construction.

THE FOUR-CHANNEL EVERYTHING.



Sansui's Model QR6500

SANSUI BREAKS THE BOTTLENECK.

The "wait-and-see" period is over. You can go ahead and overwhelm yourself with the awesome power of the total four-channel sound field right now. And tomorrow too.

Sansui's QR6500 Four-Channel Stereo Receiver makes it possible. Actually it's an AM/FM Two-Channel and Four-Channel Stereo Receiver-Synthesizer-Decoder-Amplifier and Control Center. Add four speakers (you probably have two of them already) and live. That's all there is to it.

As a synthesizer, it can ferret out the ambient signals already present in most two-channel stereo recordings and broadcasts and process them for astonishingly realistic rear-channel reproduction. Enhancing this effect is Sansui's exclusive phase-modulation technique, which moves the sound about the listening area the same way nature propagates the live sound field.

As a decoder, it can accurately reproduce the four original channels of any compatibly matrixed four-channel recording or FM broadcast. And such discs and broadcasts are here *now*, past the experimental stage, becoming increasingly popular. In this mode, Sansui's original phase-shift circuitry prevents the sound dropouts and lost sound-source localization that plague many matrixed systems. And the phase modulators are also at work to build up that "live sound field."

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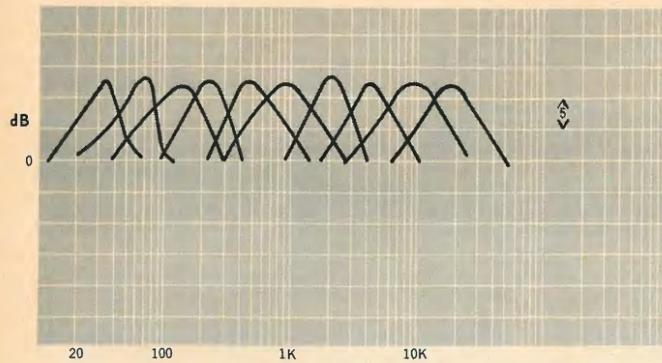


Fig. 2—Frequency response, maximum lift.

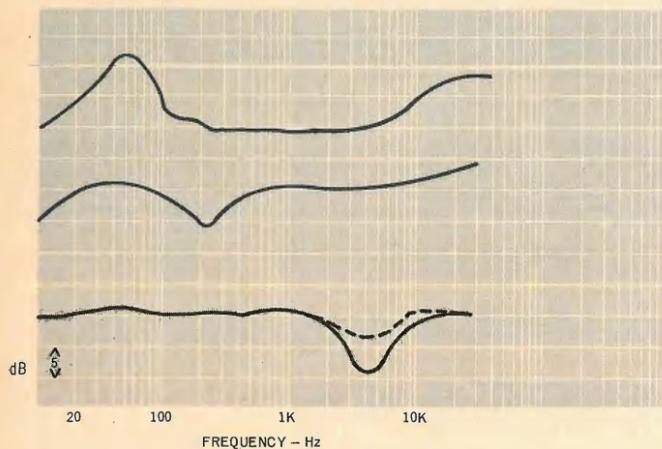


Fig. 3a, b and c—Showing possible response curves.

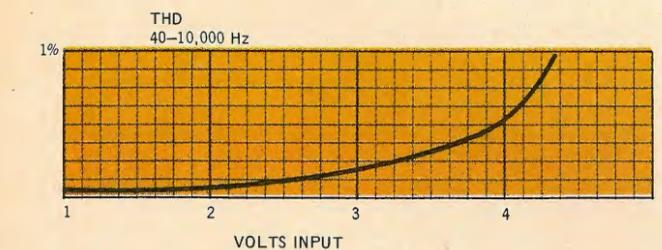


Fig. 4—Showing THD from 40 to 10,000 Hz. Gain control at X1.

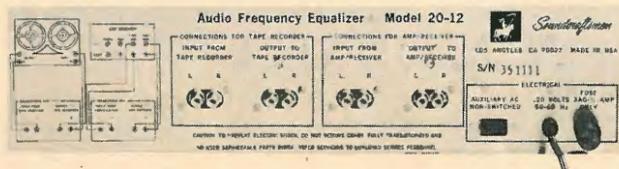


Fig. 5—Rear view.

the inductors are toroidal types. It was also noted that topgrade fiber-glass boards are employed and the components appeared to be of high quality.

Measurements

Figure 2 shows the frequency response with the controls at maximum lift. The characteristics at cut positions are an almost exact mirror image so they are not shown. Figures 3 a, b and c show the kind of curves that can be obtained with a little juggling, and fig. 4 shows the THD distortion characteristics. This does not vary between 30 Hz and 10,000 Hz and it will be seen that it is negligible at inputs below 2.5 volts. IM came out at 0.2% for 2.5 volts input but was difficult to measure below that figure. Frequency response was the proverbial straight line, being only 1 dB down at 10 Hz and 0.5 dB down at 100 kHz. As might be expected, square-wave response was very good indeed and it was practically impossible to detect any degradation of a 10 kHz square wave. Signal-to-noise measured -87dB (ref 2 volts) on one channel and -85 dB on the other. This is extremely small and the measurements had to be taken with the unit connected to an amplifier.

Performance

Well, one way to use the 20-12 is simply connect it up and then play it by ear—in other words, add just the controls until the sound is just how you like it. Perhaps a touch of the bass controls to bring up the bottom end of those bookshelf speakers and a slight reduction of the top end to tame a rather strident treble. However, it may not always be that simple, and you may be fiddling with the controls for weeks. The Soundcraftsmen engineers probably frown on this hit-or-miss idea because they make things easier by including a special test record with the unit. These offer a choice of 3 methods of adjustment. Using method A, one channel is compared with the other which is supplied with a 1000 Hz pink noise signal. The slide controls are adjusted octave by octave to balance the sound from each loudspeaker. Directions are clear enough but I imagine some people will have difficulty in balancing two different pink noise signals—especially at extreme frequencies. Method B is similar, but listeners are asked to move the speaker supplying the reference tone close to the other loudspeaker. This is certainly more accurate but as my systems (home-brew) weigh around 200 lbs each, I did not consider the idea too practical. I am much too lazy, so I turned to method C. This was definitely the best method and it merely involved changing the connections to the equalizer so both reference and test signals are alternately applied to one loudspeaker. Selection is made by the tape recorder switch and it is a simple matter to use one hand for this while the other moves the octave slide switches accordingly.

My listening room is irregular in shape and rather large, so very little equalizing was necessary with the large super-loudspeakers. However, a pair of Dynaco 25's (borrowed for the occasion) did merit more drastic treatment. Treble was lifted from about 3 kHz and bass had a lift of some 4 dB with the 40 to 80 Hz control, and a cut of 4 dB with the 20 to 40. Now, in theory the overall speaker power handling capacity might be reduced, but at normal listening levels the improvement was quite audible—no doubt about it. In really bad listening rooms, the 20-12 might be even more worthwhile and as mentioned above, it will have many other applications. It should give years of trouble-free service and can be highly recommended.

T.A.

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SCOTT 387 Receiver. The price of this receiver, reviewed in our October issue is now \$359.90, instead of \$449.95—making it an even better value!



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Heath Model AR-1500 AM-FM Stereo Receiver

MANUFACTURER'S SPECIFICATIONS

Fm Tuner Section. IHF Sensitivity: 1.8 μ V. Selectivity: 90 dB. Image Rejection: 100 dB. IF Rejection: 100 dB. Capture Ratio: 1.5 dB. AM Suppression: 50 dB. Harmonic Distortion: Less than 0.5% (Mono and Stereo). IM Distortion: 0.1% or less (mono). Spurious Rejection: 100 dB. S/N Ratio: 60 dB or better. Stereo Separation: Better than 40 dB at mid-frequencies. 19 kHz, 38 kHz and SCA Suppression: 55 dB or better.

AM Tuner Section. Sensitivity: 50 μ V (external input); 300 μ V/meter (radiated input). Alternate Channel Selectivity: 60 dB. Image Rejection: 70 dB (at 600 kHz). IF Rejection: 70 dB (at 1000 kHz). THD: Less than 2.0%. S/N Ratio: 40 dB.

Amplifier Section. Power Output (IHF Music Power): 90 watts/channel at 8 ohm load; 120 watts/channel at 4 ohm load. RMS Power: 60 watts/channel, 8 ohm load; 100 watts/channel 4 ohm load. Rated THD at Full Power Output: 0.25%. Power Bandwidth: From at least 8 Hz to beyond 30 kHz. Frequency Response: Within 1 dB from 7 Hz to 80 kHz. IM Distortion: Less than 0.1% all levels up to 60 watts/channel, 8 ohm load. Damping Factor: Greater than 60. Input Sensitivity: Phono, 1.8 mV; Tape, Aux and Tape Mon, 140 mV. Overload Sensitivity: Phono, greater than 145 mV; Tape, Aux and Tape Mon, greater than 10 volts. Hum and Noise: Phono, -63 dB (10 mV reference); Tape and Aux, -75 dB (0.25 V input reference).

General. Dimensions: 18 1/2 inches W. x 5 1/8 in. H. x 13 3/4 in. D. Weight: 32 lbs. Retail Price: \$349.95 kit; walnut cabinet ARA-1500-1, optional: \$24.95.

The problem of "what to do for an encore" has bothered many high fidelity component manufacturers for several years now, especially since solid-state designs have reached a level of performance and reliability that often approaches theoretical and practical limits. When the Heath Company introduced their Model AR-15 receiver back in 1967 it was regarded by a great many audiophiles (including this reviewer) as one of those rare "standards" by which competitive products were to be gauged. Small wonder, then, that we opened the carton of the new AR-1500 with mixed emotions—hoping that even better performance standards might be set but afraid that the AR-1500 might be another "cost saving" design to counter inflationary price tendencies. After "living with" and testing the AR-1500 for nearly one month we are happy to report that the AR-1500 outperforms the near-perfect AR-15 in almost every important specification. A glance at the listed specifications shown above will reveal that the AR-1500 has more power output, much better FM selectivity, lower distortion in FM stereo, lower IM and THD at rated output and noticeably better AM performance than its predecessor. Actually, the listed specs don't tell the entire story either, for as we will show shortly, the new specs, impressive as they are, are much more conservatively stated than were the specs of the AR-15. For example, our unit produced a big 77.5 watts

per channel (8 ohm loads) as against the "rated" power output of 60 watts per channel and we measured an IHF sensitivity of 1.5 μ V as against the stated 1.8 μ V.

While we did not have an opportunity to build the AR-1500 from a kit, we were supplied with the 245-page manual which the kit-builder would use in assembling the AR-1500. As always, construction instructions are lucid enough for the inexperienced kit-builder and there is enough technical and theoretical information to satisfy even the most knowledgeable audio/rf engineer. The completed AR-1500 front panel layout looks "less busy" in our opinion (and therefore more elegant) than did the AR-15. The righthand three-quarters of the panel is treated in "blackout" plastic, interrupted by a single tuning knob at the extreme right. The left corner of the panel, treated in gold anodized material, contains the master volume, balance, bass and treble controls. The dial area, which becomes illuminated when power is applied to the receiver, also contains illuminated signal strength and tuning meters and, centered above the dial scale, an FM stereo indicator lamp which illuminates the words FM STEREO when stereo FM transmissions are received. Fourteen slim push buttons, located below the "blackout" area, help establish the "low profile" look while affording every conceivable switching facility you might require. Starting at the left, the first pair of buttons control deactivation of the TONE control circuits (for absolutely flat response when tone controls are not desired) and introduction of the loudness-compensation circuits. A BLEND button follows (used to decrease noise when weak-signal stereo FM is received), plus buttons for MONO/STEREO and TAPE MONITOR. The next six buttons select signal sources such as TAPE, AUX, PHONO, AM and FM. There are actually two FM buttons, one labelled FM AUTO (when depressed, all FM stations are tunable) and another called FM STEREO (which electronically screens received FM signals, permitting only those received in stereo to come through). Finally, a cluster of three more buttons select main or remote speakers and turn the power on and off. Along the lower edge of the panel, somewhat set back from the front surface, are a pair of headphone jacks (you need no longer be out of communication with your wife) and a SQUELCH control which varies the muting threshold of FM reception.

The rear panel of the receiver, shown in Fig. 1, is almost completely covered with rugged heat sinks for the output transistors, whose protective plastic covers can be seen clearly in the photo. Below the heat sink area are binding posts for speaker connections, antenna connection terminals for 300 ohm, 75 ohm, and external AM antennas (obscured in the photo by the pivoting built-in AM antenna bar), the various input and tape output jacks, a pair of jacks for connection to the horizontal and vertical inputs of an oscilloscope (for multipath and antenna orientation observations) and a series of input and output jacks which are intended for separating the preamplifier from the power amplifier sections of the receiver. The preamp-amp interruption jacks are internally

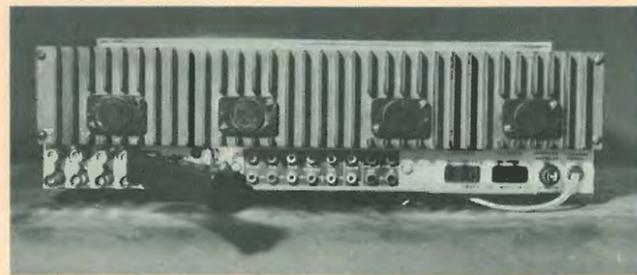


Fig. 1—Back view of the Heath AR-1500. The AM antenna is swung away from its closed position to show input and output jack panel.

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600 watts r.m.s.

M 2000
2000 watts r.m.s.

Power output 600 watts r.m.s. into 8 ohms, 20-20,000Hz at rated distortion ■ specially designed to have large operating range with highly reactive loads ■ IM distortion less than 0.1%, 0.01 watt to 600 watts ■ harmonic distortion less than 0.1%, 0.01 watt to 600 watts ■ frequency response ± 0.1 dB, 0-20,000Hz at 1 watt ■ phase response $+0^\circ$ to -15° , 0-20,000Hz at 1 watt ■ peak-reading power output indicator ■ protection against shorts, mismatching and open circuits; safe with all loads ■ commercial warranty three years on all parts, labor and round-trip shipping ■ dimensions 8 3/4" h x 12" d standard 19" rack mount, weight 80 lbs

Power output 2000 watts r.m.s. into 8 ohms, 20-20,000Hz, at rated distortion ■ specially designed to have large operating range with highly reactive loads ■ other specifications same as model M600, including warranty ■ peak-reading power output indicator ■ protection against shorts, mismatching and open circuits; safe with all speaker loads ■ dimensions 17 1/2" h x 13" d standard 19" rack mount, weight under 200 lbs



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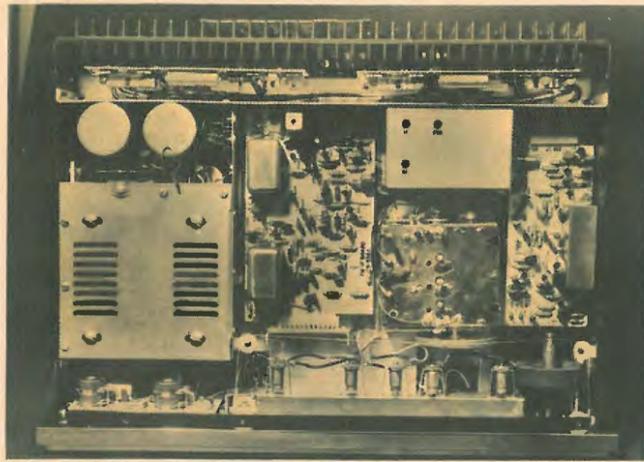


Fig. 2—Top view of open chassis.

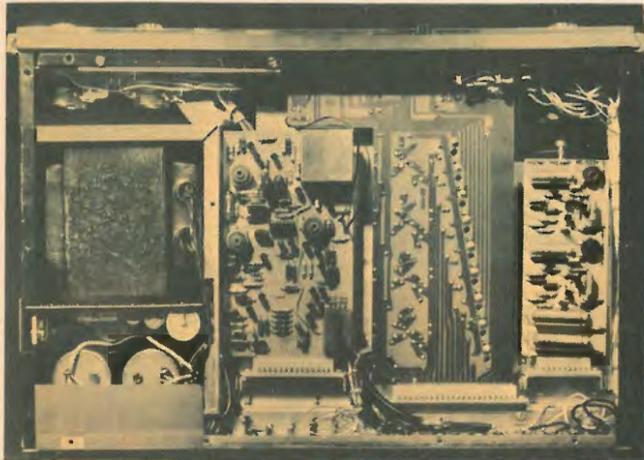


Fig. 3—Bottom view of chassis.

wired together by means of jumpers and, although the kit-builder could easily disconnect these jumpers for using the preamplifier and amplifier separately (as in bi-amp applications), it would be a bit more convenient if external jumpers with the usual pin plugs had been provided instead. Switched and unswitched a.c. receptacles and a replaceable line fuse complete the rear panel layout.

The views shown in Figs. 2 and 3 of the inside layout of the wired chassis cannot really do justice to the well thought out arrangement of modular circuit boards and chassis interwiring. There are 10 plug-in circuit boards and two pre-assembled wiring harnesses which combine to make for easy servicing and mistake-proof assembly. The plug-in board modules are inserted into pivoting connectors, which means that in most cases both top and bottom surfaces of each p.c. board can be examined, measured, and traced (in the event of trouble) without having to disconnect or remove the particular board from the rest of the circuitry. In Fig. 3 you can observe a p.c. board which has a series of nine small holes (in a straight line at an angle of about 15 degrees to the perpendicular). These give access to a series of individual potentiometers for input level adjustment of *all* signal sources, including FM and AM internal levels. The bottom cover has corresponding access holes for these level adjust functions, properly labelled for identification. We stress the importance of the level adjust controls of even the AM and FM circuits because we have never seen this feature provided in an all-in-one receiver before. The very best receivers will sometimes feature level adjust controls for equalizing the level between *outside* signal sources and internal radio levels, but with speaker efficiencies varying as greatly as they do from one type to another, the user is often confronted with the problem of either having to restrict master volume control settings to a fraction of their full rotation (when using high efficiency speakers) or having to rotate the control almost fully clockwise to attain respectable listening levels. Thus, equalizing all signal source levels is not really the entire answer, unless each source (including the built-in radio signals) can be adjusted to provide optimal use of the volume control

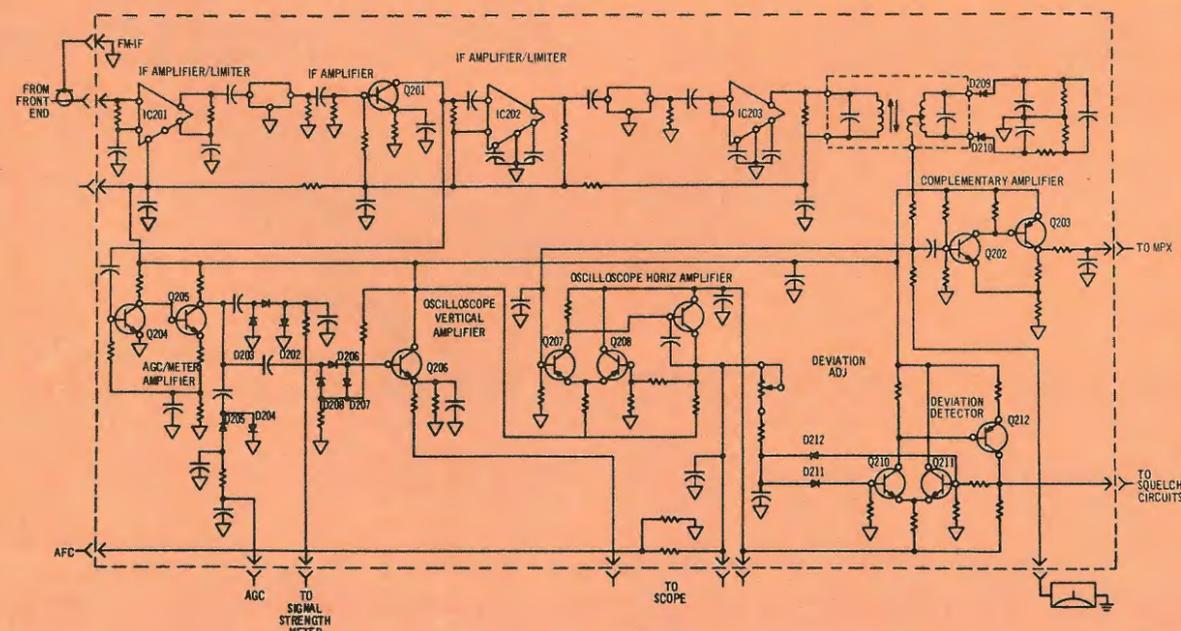


Fig. 4—Partial schematic of AR-1500 shows FM i.f. section and derivation of 'scope horizontal and vertical inputs.

NEW DYNACO FM-5

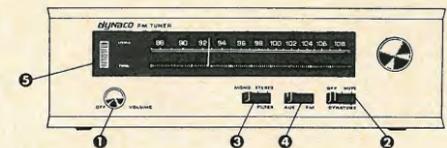


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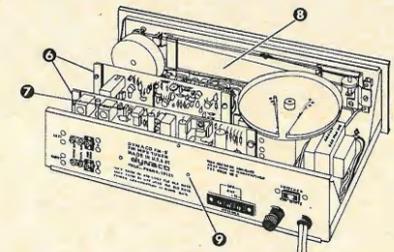
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1. Front panel level control and power switch
2. Switch for Dynatune plus Muting; Muting only; neither one
3. Switch for Stereo (automatic mono/stereo switching); Stereo Filter (reduces noise and treble separation); Mono
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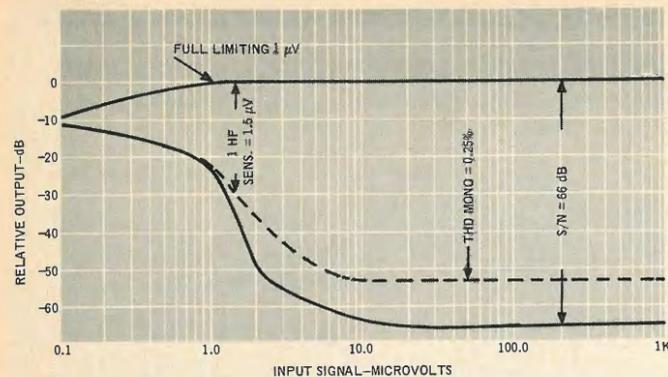


Fig. 5—FM (mono) characteristics.

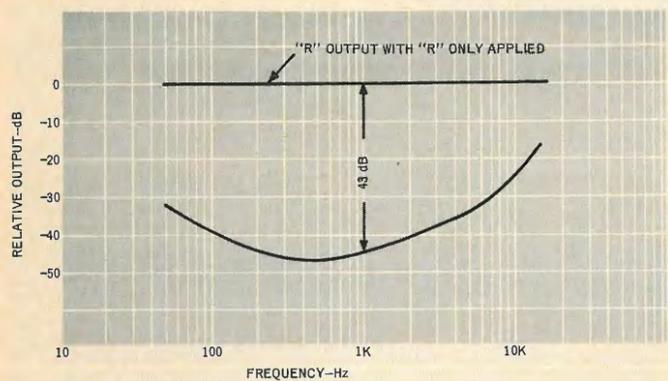


Fig. 6—Stereo FM separation.

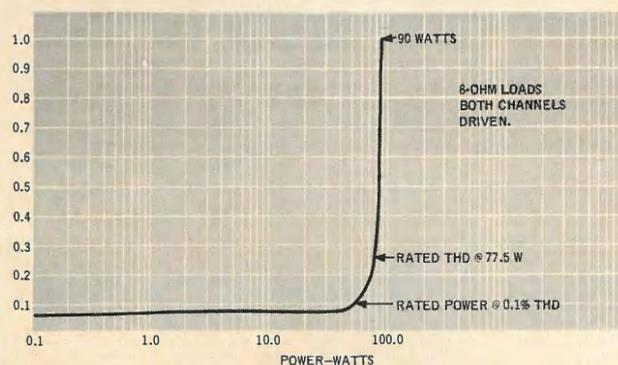


Fig. 7—Power output vs. distortion (THD).

(and, thereby, enable the loudness circuits to provide useful compensation when required). The Heath AR-1500 is the first receiver we have ever seen that provides *all* these niceties, thanks to the multiplicity of input level controls.

The Circuits

The power amplifier sections feature direct coupling to the loudspeakers and utilize positive and negative 43 volt supplies. Differential input amplifier stages are used and a pair of "dissipation limiter" transistors serve as a protective circuit against overloads and possible short circuits at the speaker terminals. The FM front-end features six tuned circuits and utilizes three FET's, while the AM r.f. section has two dual-gate MOSFET's (for r.f. and mixer stages) and an FET

oscillator stage. The AM i.f. section features a 12-pole LC filter and a broad band detector. The FM i.f. section is shown schematically in Fig. 4 and is worthy of special comment. Three IC stages are used and there are two 5-pole LC filters. The lower portion of the partial schematic serves as the a.g.c. circuit, the tuning meter circuit and the 'scope output circuits. A part of the 10.7 MHz signal from Q-201 is amplified by Q-204 and Q-205, rectified by D204 and D205 and then applied as a.g.c. to the r.f. stage of the FM front-end (not shown). The amplified signal from Q205 is also coupled to full wave rectifiers D-201, D-203. Diode D-202 acts to protect the signal meter against damage from high signal levels. The rectified voltage thus formed is coupled through resistor R225 to the signal meter (not shown). The signal from Q205 is also coupled to the rectifier circuit consisting of D206 and D208. The rectified output is coupled to the base of Q206 where after amplification it is applied to the "Scope Vertical" jack. A part of the audio signal at the ratio detector (T-201) is fed back to the base of Q-207. This transistor together with Q208 and Q209 form a differential amplifier circuit that amplifies a.c. as well as d.c. and the amplified signal from this circuit is coupled to the "Scope Horizontal" jack. The "Deviation Adjustment" control shown in the schematic has to do with settings for the very effective "squelch control" circuit (not shown) which is sensitive both to incorrect tuning and noise in the FM signal.

A great deal more could be said about the various circuit modules used in the AR-1500 but since most readers are probably more interested in performance, we shall go on to actual measurements.

Electrical Performance

As has been noted, IHF FM sensitivity (depicted in Fig. 5) turned out to be $1.5 \mu\text{V}$ as opposed to the $1.8 \mu\text{V}$ claimed. Furthermore, it was *identical* at 90 MHz and 106 MHz (the IHF spec requires a statement only for IHF sensitivity at 98 MHz but we always measure this important spec at three points on the dial). Notice that at just over 2 microvolts of input signal S/N has already reached 50 dB. Ultimate S/N measured was 66 dB and consisted of small hum components rather than any residual noise. THD in Mono measured 0.25%, exactly twice as good as claimed! Stereo THD (not shown) was identical, at 0.25%, which is quite a feat when you consider what additional "tortures" the recovered composite signal has to go through to become "L" and "R" recovered signals. Stereo FM separation, shown in Fig. 6, was as good as we have ever measured in a complete receiver. Happily, we now have the use of a new piece of equipment made by Sound Technology, Inc., of California. This combination FM-Stereo generator comes just in the nick of time and enables us to "guarantee" measurements of THD in FM down to 0.1% and stereo separation figures to 50 dB! With the kinds of specifications now listed for the current generation of high fidelity components, such as the AR-1500, this new equipment will finally allow us to abandon our old "excuse" of "not being able to confirm or deny because of generator limitations." In any event, the separation of the multiplex section of the AR-1500 reaches about 45 dB at mid-band and is still 32 dB at 50 Hz and 25 dB at 10 kHz (can your phono cartridge do as well?).

Figure 7 plots THD versus power output per channel for the AR-1500. Rated distortion is reached at a power output of 77.5 watts per channel with 8 ohm loads (both channels driven). At rated output (60 watts per channel) THD was a mere 0.1% and at lower power levels there was never a tendency for the THD to "creep up" again, which indicates the virtually complete absence of any "crossover distortion" components. No so-called "transistor sound" from this receiver, you can be sure. We tried to measure IM distortion

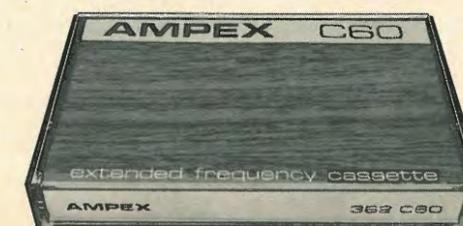


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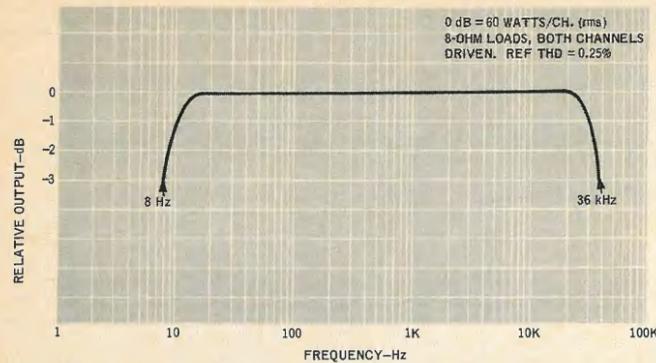


Fig. 8—Power bandwidth.

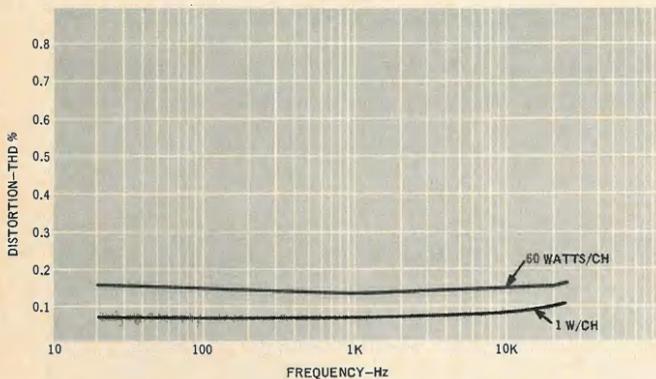


Fig. 9—Distortion vs. frequency at 1 watt and 60 watts per channel output, 8 ohm loads, both channels driven.

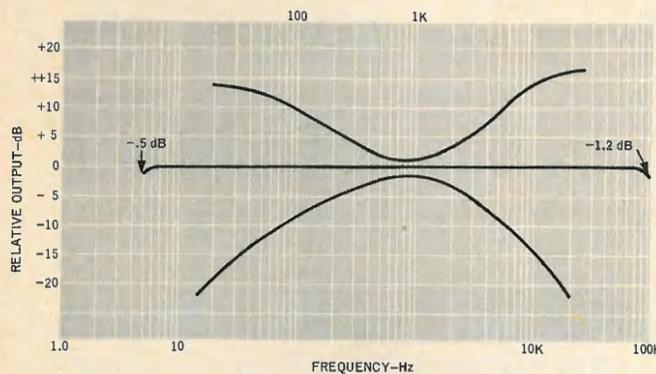


Fig. 10—Frequency response and tone control characteristics.

but kept getting readings of 0.05% no matter what we did. Since that happens to be the "limit" of our test equipment and since the rated IM stated by Heath is "less than 0.1% at all power levels up to rated power output" there isn't much more we can say except that, again, the unit is better than the specification—we just don't know *how much* better.

Power bandwidth, shown in Fig. 8, extended from 8 Hz to 36 kHz and, while we have shown the "0 dB line" at 60 watts, the amplifier did much better than that for 0.25% THD at all frequencies from 20 Hz to about 30 kHz. We also plotted THD versus frequency at 1 watt and 60 watt levels and, as you can see, in Fig. 9, the two lines are virtually *straight*, never even approaching *rated* distortion at any audible frequency. Finally, frequency response curves and tone control range are plotted in Fig. 10. Hum and noise in phono exceeded published specifications by about 3 to 4 dB while hum and

noise figures for other signal source inputs agreed closely with published figures.

Using the AR-1500 Receiver

When you get down to the kinds of sensitivity and selectivity we're talking about in the case of the AR-1500 and receivers of its ilk, it's almost impossible to differentiate between the performances of some of these products. As we remember it, the FM performance of the earlier AR-15 was great and so is that of the AR-1500. The squelch action of the newer unit does seem to be a bit more effective, however, in that we can set it for a threshold of about 2 μ V (range is from about 1 μ V to 5 μ V) and receive every station worth listening to and yet enjoy complete interstation silence. The FM STEREO ONLY button is a joy to use and simplified our "station logging"—we received 26 very listenable stereo stations with outdoor medium-gain Yagi array. Total count (without use of a rotator) of all FM signals was 53 at our near-New York location. Alignment was *perfect* as between signal strength and center-of-channel meters across the entire dial and there were no false stereo light indications. FM sound, particularly in stereo, is so clean that in the few instances when we were able to listen to "live" broadcasts (yes, there are still a few on FM) we truly realized what the potential of FM can be in terms of high fidelity medium.

The real surprise came when we spent some time listening to AM. The AM section of the older AR-15 had been, frankly, just adequate. This new AM design is *superb*. We still have *one* classical music station that has some simultaneous broadcasting on its AM and FM outlets and that gave us a good opportunity to A-B between the AM and FM performance of the AR-1500. There was some high-frequency roll-off to be sure, but BOTH signals were virtually noise-free and we were hard pressed to detect more THD from the AM than from the FM equivalent. Given AM circuits like this (and a bit of care on the part of broadcasters), AM may not be as dead as FM advocates would have us believe!

As for the amplifier and preamplifier sections, we just couldn't hear them—and that's a commendation. All we heard was program material (plus some speaker coloration, regrettably) unencumbered by audible distortion, noise, hum or any other of the multitude of afflictions which beset some high fidelity stereo installations. The controls are easy to use and quickly become familiar. About the only ones we wish might have been included are a pair of low and high frequency filters with 12 dB per octave roll-off characteristics to take care of the minute amount of turntable rumble we still have and to "clean up" some of our older recordings. No doubt Heath feels that anyone who assembles their best receiver ought to know enough to use equally top-notch source material and associated equipment—and with that, we blushing agree.

We cannot comment on the construction aspects of this kit, since ours came fully wired, but from the looks of it (and the completeness of the manual) we would guess that it does not present any undue hazards. As of this writing, we don't believe that Heath is offering the receiver in "wired" form and that is indeed a pity, since not everyone who wants a receiver of this quality is ambitious enough to undertake home construction. On the other hand, if you *do* spend the \$349.95 for the kit and put in the necessary time to assemble it, you will not only have the "pride of accomplishment" which the people at Heath talk about, you'll have a stereo receiver easily worth *twice* the cost (or perhaps even more) judging by what's available in "ready to plug in" high priced, high-quality stereo receivers.

EDITOR'S NOTE: Heath informs us that they will shortly be making a wired version available.

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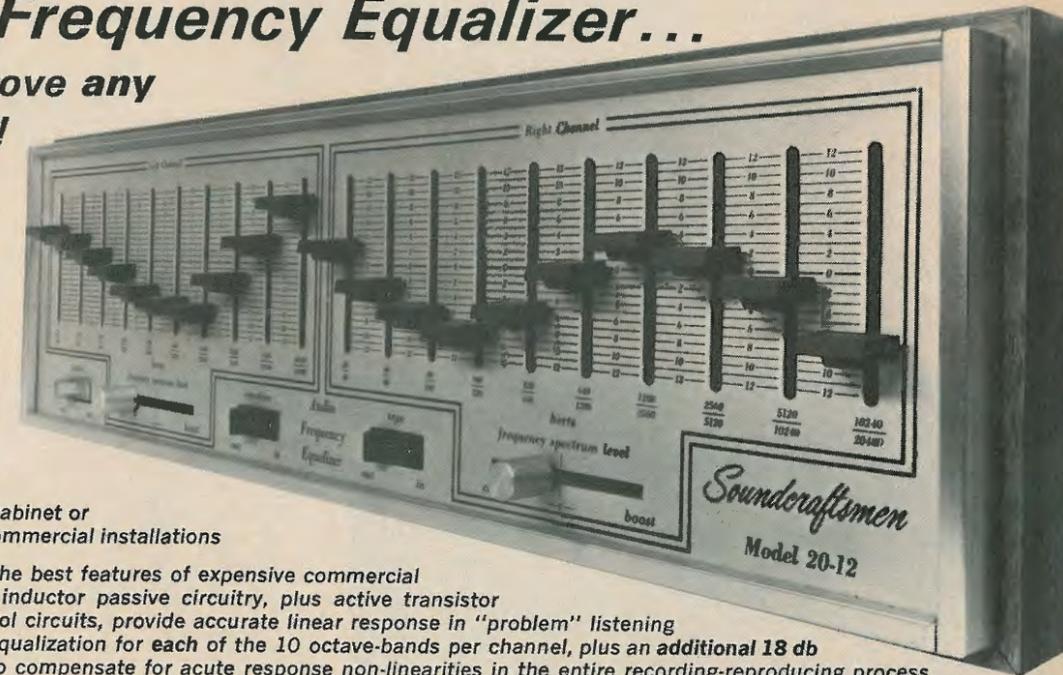
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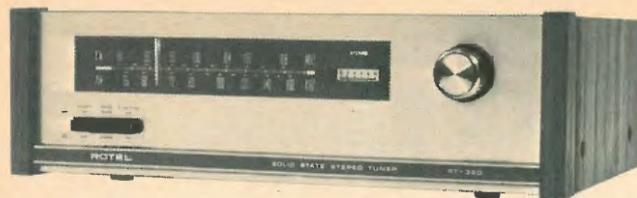


SPECIFICATIONS and SPECIAL FEATURES

TOROIDAL and ferrite-core inductors, ten octave-bands per channel.
FREQUENCY response: $\pm 1/2$ db from 20-20,480 Hz at zero setting.
HARMONIC DISTORTION: Less than .1% THD @ 2 v., Typ: .05% @ 1 v.
IM DISTORTION: Less than .1% @ 2 v., Typ: .05% @ 1 v.
SIGNAL-TO-NOISE RATIO: Better than 90 db @ 2v. input.
INPUT IMPEDANCE: Operable from any source 100K ohms or less — (any Hi-Fi Pre-amp, Receiver or Tape Recorder.)
OUTPUT IMPEDANCE: Operable into 3K ohms or greater — (any Hi-Fi Amp, Receiver or Tape Recorder.)
CIRCUIT BOARDS: Military grade G-10 glass epoxy.
RESISTORS: Low-noise selected carbon-film.

RANGE: 12 db boost and 12 db cut, each octave.
MASTER OUTPUT LEVEL: "Frequency-spectrum-level" controls for left and right channels, continuously variable 18 db range, for unity gain compensation from minus 12 db to plus 6 db.
MAXIMUM OUTPUT SIGNAL: variable Master "frequency spectrum level" Controls allow adjustment of optimum output voltage for each channel, to exactly match amplifier capability, up to 7 v.
SIZE: designed to coordinate with receivers, comes installed in handsome walnut-grained wood receiver-size case, (5 1/4" x 17 3/4" x 11").
WARRANTY: 2-year parts and labor.

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Rotel Model RT-320 AM/FM Stereo Tuner

MANUFACTURER'S SPECIFICATIONS

FM SECTION. IHF Sensitivity: 2.2 μ V. S/N Ratio: Better than 65 dB. THD: Less than 1.0%. Image Rejection: 60 dB. IF Rejection: 80 dB. Selectivity: 45 dB. Stereo Separation: 35 dB @ 1 kHz. Spurious Response: 80 dB. Capture Ratio: 3dB.

AM SECTION. IHF Sensitivity: 25 μ V. Image Rejection: 50 dB @ 1MHz. IF Rejection: 50 dB @ 1MHz. Selectivity: Better than 30 dB. S/N Ratio: 50 dB.

GENERAL. Power Requirements: Either 100, 117, 200, or 240 V. a.c., 50/60 Hz. Dimensions: 14 in. W. \times 7 1/2 in. D. \times 4 1/2 in. H. Price: \$119.00.

To get reasonable performance in a separate tuner component, the audio enthusiast intent upon assembling his system from separate components has generally had to pay a great deal more than \$119.00—the suggested list price of this neatly designed solid-state tuner from Roland Electronics Co., Ltd. of Tokyo, Japan. Matched with its companion amplifier, Model RA-310, which bears a similar price tag, the user who desires the flexibility associated with separates but faced with a budget limitation of around \$250.00 can come up with a pair of winners that's hard to beat in the current market. The RT-320 tuner comes complete in its own enclosure consisting of a black metal top, flanked by two oil-walnut side panels. This treatment surrounds a simple but elegant black and gold front panel which features only three push buttons and a good-sized tuning knob coupled to an effective flywheel. The buttons are of the "push-push" type and serve as POWER switch, MONO-STEREO selection, and AM-FM selection. The calibrated dial scale is illuminated in green when power is applied and the dial pointer also becomes brightly illuminated through use of a miniature travelling lamp and the plastic, light-transmitting material of which the pointer is constructed. A peak-reading signal strength meter is located at the right of the dial scale and, just above it, the illuminated word STEREO appears when a stereo station is tuned in.

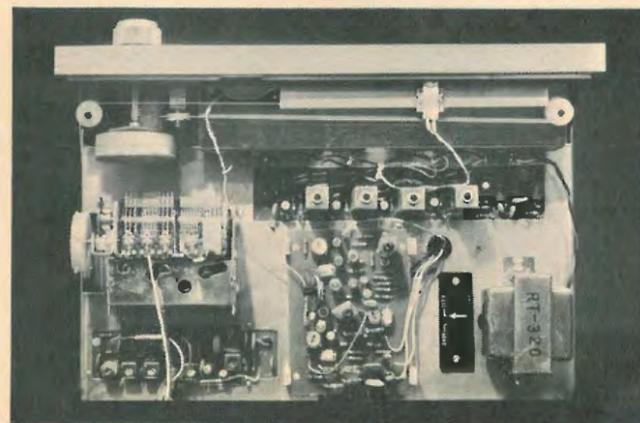


Fig. 1—Internal view of the RT-320 chassis.

Rear panel layout includes terminals for 300-ohm antenna input as well as terminals for an external AM antenna, if desired. Right channel and left channel output jacks and the usual built-in AM loopstick complete the rear layout.

A look at the internal chassis discloses a separate, sealed FM front-end assembly, which also contains the AM variable capacitor but, as is the case with much more costly sets, separate AM and FM i.f. sections are used. Circuitry is, for the most part, conventional in both of these sections, utilizing bi-polar transistors throughout in the four FM i.f. stages. The multiplex section is of the switching type and is "gated on" by a novel threshold circuit shown in the partial schematic of Fig. 2. Adjustment of VR-101 varies both a.g.c. level to earlier i.f. stages and also sets up the bias level at the output of the pair of d.c. coupled amplifiers which alters the gain of the 38 kHz amplifier in the MPX section of the tuner (not shown in the schematic) to determine the optimum point at which the stereo circuitry is "gated on" based upon adequate signal strength and noise-free reception.

Performance Measurements

The manufacturer's specifications listed at the beginning of this review were taken from the manufacturer's descriptive literature. Customer's instruction booklets supplied with the unit list somewhat more conservative specifications and, upon conferring with the manufacturer to determine the reason for this discrepancy we were told that the manuals were written and printed before production began and that, in fact, the production runs have actually proven to provide better specs than were anticipated. We can confirm from our own measurements that this is true. In fact, some of the measurements turned out to be better than the revised specifications too. Important FM performance specs are shown in Fig. 3. IHF sensitivity of the unit we tested was 2.0 μ V, as opposed to the 2.2 μ V claimed. (The earlier booklet claimed 2.5 μ V.) THD in mono was 0.8%, while in stereo this figure goes to 1.0%. Ultimate signal-to-noise was an impressive 67 dB, while full quieting was achieved at a signal input of 2.7 μ V. Quieting is quite steep, reaching 50 dB of S/N at a mere 3 μ V input. Stereo FM separation shows a mid-band figure of 36.5 dB as opposed to 35 dB claimed. Separation holds very well all the way down to 50 Hz but decreases at the high end, reaching 15 dB at 15 kHz. In terms of aurally perceived stereo separation at the high end, this figure is still more than adequate.

Although the AM circuit is extremely simple (a converter stage followed by two conventional i.f. stages), we were pleased to find that AM performance was excellent—better than that measured in some receivers which include a separate r.f. stage. For example, the AM IHF sensitivity was measured as 15 μ V (through the external AM antenna terminals, using a

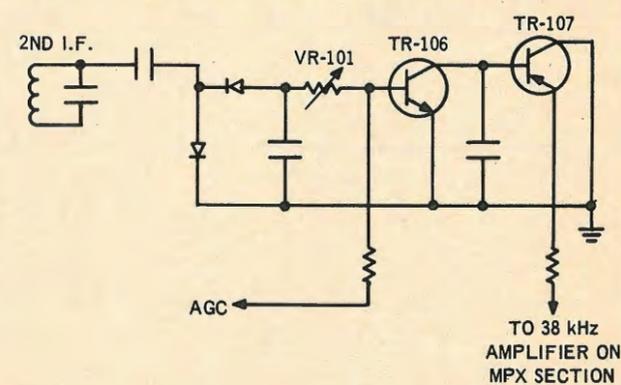


Fig. 2—Combination a.g.c. and stereo threshold circuit used in the RT-320. TR-106 and TR-107 determine bias setting of MPX 38 kHz amplifier.

From Julian Hirsch's Review of the Advent Model 201 Cassette Deck:



"The Advent 201 easily met its specifications, and established itself—at least for now—as the best cassette recorder we know of. Having used it to evaluate the forty types of cassette tapes in a survey report, we have a familiarity with, and a respect for, its capabilities."

"With Advocate Crolyn tape, the response variation was less than ± 2 db from 31 to 15, 500 Hz."

"It should be noted that the noise was totally inaudible, even at extremely high playback levels... If the 3 per cent distortion level is taken as the reference point for signal-to-noise specification (as is the case with most open-reel machines), the Advent 201 could fairly be rated at 60 db!"

"It is difficult to restrain our enthusiasm for the Advent 201. The unit came with a demonstration tape that had been dubbed onto

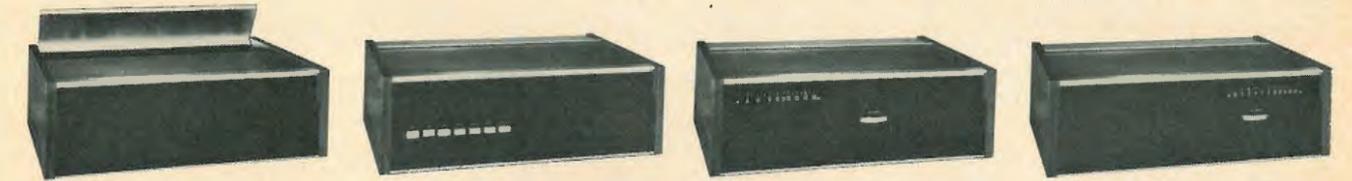
Crolyn tape by that specific machine from a Dolby "A" master tape. The sound quality, especially with the finest playback amplifiers and speakers, was literally awesome, as was the total absence of hiss or other background noise."

"Summarizing, the Advent 201 is a tape deck of superlative quality. It is difficult to imagine how its sonic performance could be substantially improved... this is the one that sets the standard for cassette recorders."

We will be happy to send you a reprint of the complete review from the October issue of Stereo Review, which also compares the Model 201 favorably against the best open-reel tape machines, and a list of Advent dealers who will be happy to let you see and hear the Model 201 for yourself. Please write:

Advent Corporation, 195 Albany Street, Cambridge, Massachusetts 02139.

As new and brawny as the Mark IV. As different as the 280SL. Isn't that what you'd like to get in a 399⁹⁵ stereo receiver?

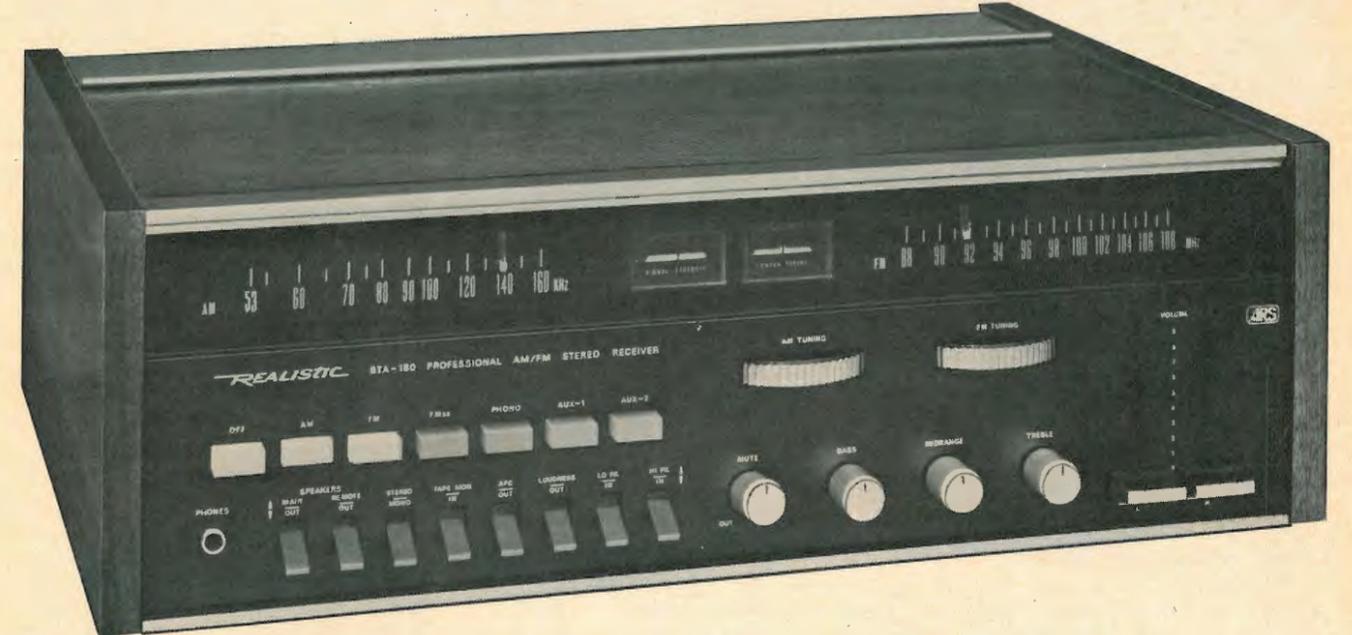


Front Access "Flip-Top." You can connect, disconnect and reconnect all audio cables without moving the receiver. The most difficult hook-ups now made easy. Only Realistic has it!

Power/Program Pushswitches. Five of them turn on the receiver. And select a function, and light-up to very visibly identify it. The 6th turns off the receiver—no need to keep resetting volume. Very handy. Only Realistic has them!

Independent AM Front End and Dial. Because you need it for true wideband AM sound. It approaches FM quality. And you don't have to detune one band to tune the other. This is the way it should be in the top-of-the-line.

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The most innovations in a decade—everything for the serious music lover. A midrange tone control for emphasizing or de-emphasizing vocalists. Tape facilities so complete you can dub from two tape decks in either direction. Variable FM muting. An FM dial pointer that glows "white" on stereo, "red" on mono. Realistic-invented "FM Stereo Select" for automatic stereo-only tuning, "Glide-path" sliding volume controls with "Perfect Loudness" for correct tone compensation at all listening levels, "Flip-Lever" switches for visible indication of a non-normal position. 200-watt power. The Realistic STA-180, with \$29.95 value walnut case included—underpriced (because we sell factory-direct!) at our store near you.*



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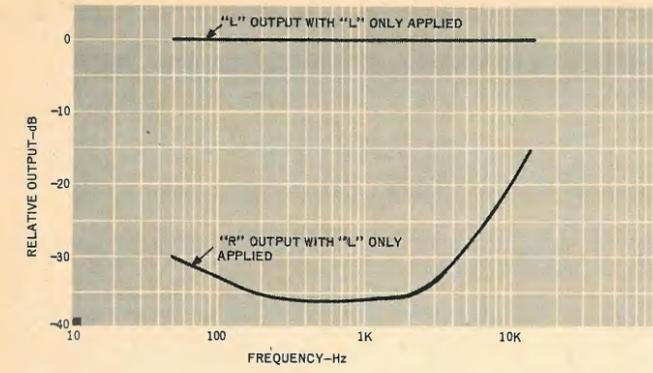


Fig. 3—FM performance characteristics.

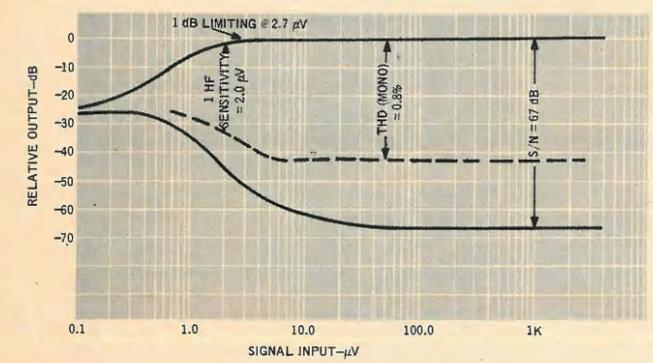


Fig. 4—Stereo separation characteristics.

recommended dummy load) as opposed to the 30 μ V claimed by the manufacturer. Proper a.g.c. circuit design and optimization of the operation point of each stage accounts for this excellent performance from what appears, schematically at least, to be a minimal circuit.

Output level from AM, at 30% modulation and with 1 mV of signal applied, measured 0.5 volts and signal-to-noise ratio for this level of input was 50 dB, exactly as claimed, while AM selectivity measured 35 dB, a bit better than claimed. In FM, 30% modulation resulted in an output of 0.4 volts rms at 400 Hz. Since the tuner is not equipped with an output level control, these output figures are important in terms of compatibility with associated amplifier equipment. When used with the matching RA-310 amplifier, its volume control settings for these outputs were "comfortably" at mid-rotation for room-filling listening levels.

Listening Tests

The RT-320 pulled in some 53 listenable FM signals using our outdoor multi-element directional antenna. Some 22 of these were stereo signals, of which three were somewhat noisy and would be considered "fringe area" signals. This tabulation confirms the excellent sensitivity figures measured and is typical of the results we expect in this location with a "2 microvolt" set. There is little point in mentioning some of the features that *might have been included* when one remembers the price of this well-designed tuner. Engineering has concentrated on straight performance and has omitted the "extras" in the interest of coming up with a low-cost product that fills a real need in a category where, to our knowledge, no such product existed before. In summary, the RT-320 looks and acts like its higher priced cousins and, whether you're just starting to assemble a component system or need to add a tuner to your "audio-till-now" components, don't overlook this one.—Leonard Feldman

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The Acoustic Synthesizer

Luciano Berio: *Epifanie*; *Folk Songs*.
Cathy Berberian; BBC Symphony Orch.,
Juilliard Ensemble, Berio. **RCA LSC**
3189, stereo, \$5.98.

An absolutely astonishing and fascinating contemporary disc, this, for any ear—even those which may be pained. Such orchestral sounds as you have never imagined, a distillation of all the electronic music you've heard, and yet it comes from no tape but, rather, a large conventional orchestra, augmented to size via a batch of exotic but standard extras—tam-tam, tom-tom, wood blocks, bongos, cowbell, chimes, etc. No electronics. Just orchestral sound. And no steel plates, wind machines, beer bottles or other uncouth acoustic sound makers. Not an instrument that isn't regularly available to any orchestra.

With this orchestra, an outwardly "standard" soprano soloist. Some soloist! Some vocal part!

Then, on Side 2, as though to say—look, I'm no freak, I'm just a versatile composer and musician—the same Luciano Berio offers us as slick and pleasant a set of folk song arrangements as you could hope to find, smooth as butter, via a small orchestra and the same Cathy Berberian, for whom they were also written. They range, incredibly, from John Jacob Niles' "I Wonder as I Wander" and "Black is the Color of My True Love's Hair" through a brace of snappy Italian and French songs and one Armenian (via Cathy) to, wonderfully, a pair of those exotically popular turn-of-the-century "Songs of the Auvergne" arranged by Canteloube, rearranged by Berio. There are even two songs by Berio himself, *à la* Joan Baez or something. And not one of these would hurt a musical fly.

Yet the artfully dissonant instrumental colors and shapes in the accompaniments, you'll see, definitely match up to the extraordinary sounds on Side 1. Yes, it is the same composer, the same musician. Maybe you'd just better start out with Side 2, the folk songs, to store up a bit of confidence. You'll need it. Then, when you get to liking Mr. Berio, flip quick to Side 1.

Wow, O wow. How can I describe the music? "Epifanie" is made up of two sets of pieces intermixed, seven for orchestra and five for vocal solo; there are ten possible combinations of the two sets which can be tried, each to a different effect. In this recorded version a few seem to be missing (though my astonished ears may have counted wrong), perhaps to fit the LP length. No matter—you won't notice.

In the orchestra, an enormous spreading stereo cacaphony of squawks, roars,

Classical Record Reviews



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tweaks, jabs, toots, blats, rolls, a hundred instruments on a hundred different tracks, the vast texture made up largely of single, isolated notes, devoid of conventional melody and, of course, totally removed from even the most minute trace of "harmony." Yet such a disciplined, spare, taut sound, so sharply transparent, every bit of texture clearly audible! Expressive, I say, and (in case you're thinking) a zillion miles from mere noise. Much more colorful, and more eloquent, than any electronic/tape equivalent I can think of, whatever the synthesizer. You still can't beat "live" sound! And the recording is superb, the sonics deliciously right for big stereo fi. Terrific. But it ain't Brahms, I warn you. This is the ultimate modern, for orchestra.

As for the voice, Cathy Berberian, she is unbelievable if you listen carefully. Her part calls for the most extraordinary tonal leaps, up and down, all over the place, from tenor to soprano, totally without harmony or key (of course) nor any other apparent pitch reference; yet she does it all as accurately as if she were tossing off a slightly addled version of "Silent Night." What an ear, what a voice! And she must interpolate spoken words, syllables, between the flying leaps, or launch into rapid-fire French monologue, or sing James Joyce in English, all against a totally dissonant orchestra. If you think the human voice was made to sing Puccini or, maybe, George Frideric Handel, pay heed to our Cathy. An extraordinary vocal musician.

Isn't it odd, by the way, how the more advanced types of *live* music these days sound more and more like *electronic* music? The two are already merging into a common vocabulary and the

normal sound of bassoons, oboes, violins, and clarinets will soon be indistinguishable from so many Moogs and Arps and Buchlas. Thus we advance, and the twentieth century comes to fruition, maybe. Imagine it, only a few years ago the prototypes of the Moogs and Arps and Buchlas were trying their best to sound like bassoons, oboes, violins and clarinets. Crazy.

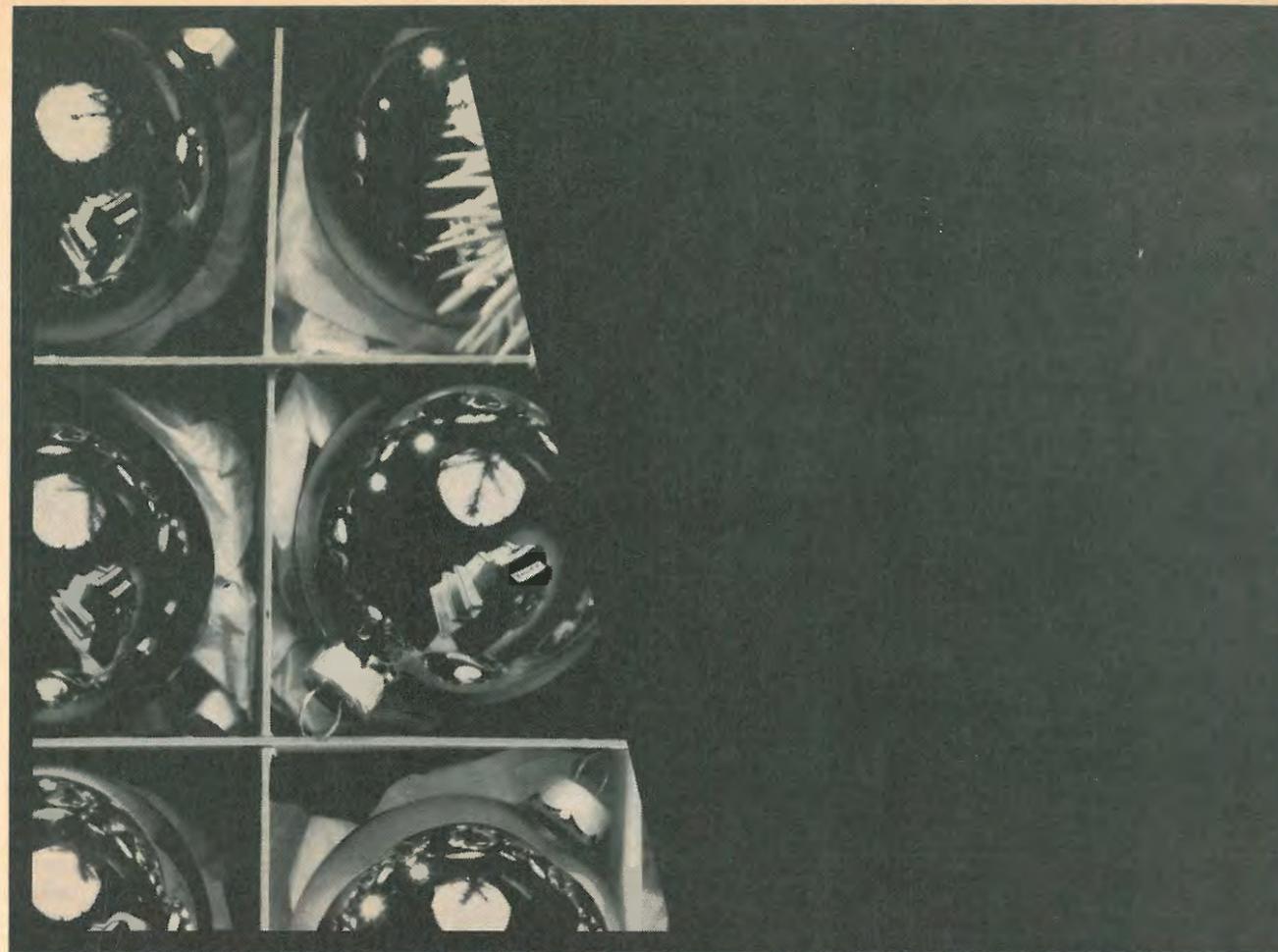
Performances: A Sound: A

Beethoven: Concerto in D, Op. 61a.
Peter Serkin, piano; New Philharmonia,
Ozawa. **RCA LSC 3152**, stereo, \$5.98.

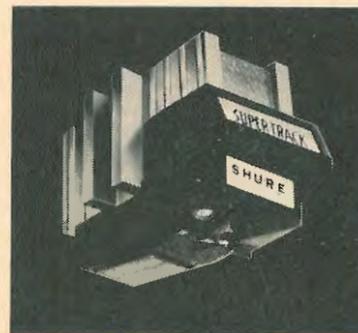
This is a very beautiful and revealing record. Familiar music—the Beethoven Violin Concerto—in an unfamiliar alternative piano version arranged by Beethoven himself for the English-based publisher, pianist, and composer Muzio Clementi. The violin line remains virtually intact in the piano right hand; simple accompanying material is added for the left. The orchestral parts are untouched, except for the significant addition of an extraordinary cadenza that includes the orchestral timpani.

A mere arrangement? I can only say that the sublime and leisurely lengths of this great piece have never been more warmly portrayed than here, via the piano. Perhaps it is in the performance. The piece is so vast, and so contemplative; Serkin and Ozawa (is it Serkin's idea? I suspect so) take it with full slowness, the slowest I seem to have ever heard the music, and yet the tension is maintained, the structure builds, there are no letdowns. Quite amazing. Violin pros take notice.

The newly added cadenza, unprecedented (except in Bach, who did

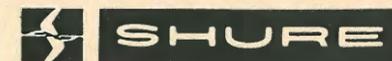


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A gift of the *Shure V-15 Type II Improved* stereo phono cartridge will earn you the eternal endearment of the discriminating audiophile who receives it. What makes the V-15 such a predictable Yuletide success, of course, is its ability to extract the real sound of pipers piping, drummers drumming, rings ringing, et cetera, et cetera. Stereo Review, in a test report that expressed more superlatives than a Christmas dinner, described the performance of the V-15 Type II Improved as ". . . . Unstrained, effortless, and a delight to listen to." All of which means that if you're the giver, you can make a hi-fi enthusiast deliriously happy. (If you'd like to receive it yourself, keep your fingers crossed!)

Shure Brothers Inc.,
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the same sort of thing in the Fifth Brandenburg written-out cadenza) is a whole big, new section of music by Beethoven himself, exploring the main first-movement themes, adding remarkable impact via the accompanying timpani as they pound away on the Concerto's principal motive. The music is worth hearing just for this alone. (Beethoven also wrote out remarkable—and not often used—cadenzas for his other piano concerti at this same time.)

I didn't measure it, but the first side of this disc is about the longest I think I've ever heard. Or did the performers have me hypnotized?

Performance: A- Sound: A-

Beethoven: Hammerklavier Sonata, No. 29, Op. 106. Rudolph Serkin. Columbia M 30081, stereo, \$5.98.

The last Sonatas of Beethoven, like the last five String Quartets, live in a

strange higher realm of musical expression—anybody can tell, merely hearing them. The Quartets are tough enough to play; the Sonatas far more so, not only because of their uncouth and finger-twisting complexity, their enormous span, their remarkable moodiness and sudden striking changes of key, but because simply to enter that higher realm of expression takes from a pianist a largeness of musical understanding and feeling that few can manage. Very few. One plays them from the inside out. One becomes deaf with Beethoven; the music must somehow be heard as he heard it, from inside an eternal silence.

Rudolph Serkin, the elder and father of Peter Serkin, has lived a whole life with this kind of music, wholeheartedly and in complete honesty. His "Hammerklavier," a whole LP for one sonata, is surely up with the best, and well ahead of a good many more robust versions by much younger pianists—for, of course, everybody tries the Sonata and masters its technical problems quick-like, to show it can be done. In this recording, then, we sense a mature mind, the only sort that can really play late Beethoven. This, no more, is 95 percent of the argument in Serkin's favor.

Curiously, it is not one of the top versions as I hear it. The ultimate pianistic depth is not quite there. I would guess that somehow Serkin is too outgoing, too ebullient as a person, to sink far enough into this great, eccentric music. For all its expressive enthusiasm—and, needless to say, its entirely adequate technique with the fingers—it somehow does not pull quite the full weight.

I think there is a further reason, not easy to put on paper. Serkin has an unaccountable fault of "ear" in respect to the classical shapes of harmony and key structure, which shows up in his late Beethoven and late Schubert in particular. No problem with the earlier, simpler works; there, the relationships of tones are mostly straightforward. But in the complex late classic-period works he apparently does not hear certain remarkable or notable changes of key, odd and portentous effects (to use inadequate language), which are vital to the very sense of the music. Since both composers build *primarily* out of these tonal relationships, which surface dramatically at big moments in their works, to perform without somehow bringing this aspect forward, like emphasizing the key word in a long sentence, is to weaken a whole musical dimension. This odd lack shows up—for my ear—at key points in Serkin's Hammerklavier. Magnificent moments that are simply *played*, passed over as

though they were nothing special. Astonishing.

Some readers will follow me, and may hear what I mean as they listen. Some won't. No more can be said. Fact remains, even so, that this is a superior performance, one of a half dozen or so really worth owning on records.

Performance: A- Sound: B

Musica Aeterna at Tully Hall. (Charpentier: La Peste de Milan. Schubert: Nachthelle, Op. 134; Ständchen, Op. 135. Brahms: Gesänge für Frauenchor, Op. 17.) Soloists, Musica Aeterna Chamber Orch. and Chorus, Waldman. Decca DL 79437, stereo, \$5.98.

Good to find Decca's somewhat embattled classical label still striving valiantly to get down American performances on its records—where most companies take refuge in cheaper Europe. This disc is uneven but interesting, with out-of-the-way music by two big Romantics and a middle sized Baroque composer. The performances under Frederic Waldman are decidedly New Yorkish (how clearly that city's tense, high-pressure music contrasts with music from other places!)—which in this case is not a total disadvantage. Helps the impact.

Side 1 goes to Marc-Antoine Charpentier, a French Baroque cantata for solos and double chorus concerning the sad fate of Milan visited by the plague in 1576. Milan's bishop, later Saint, Charles Borromeo waded in and helped mightily to straighten things out; the second half of the piece sings his praise. Mr. Waldman's soloists are not very convincing. The soprano sings tensely and mostly flat, the bass is pompous. Of two tenors, one is excellent—it could be Leo Goeke. (Can't tell which is which.) The double chorus not only is scarcely mentioned in the jacket billing but sounds that way. Unspirited, and too bouncy. Waldman is no great Baroque man.

Side 2 is much the better part. The two Schuberts, neighboring in opus, are for solo voice, piano and men's chorus, the youthful Brahms songs for two horns, harp and women's chorus—nice programming contrast. The Schuberts are heavenly, and quite unique in format: a steady pulsing piano, short, eloquent bits of melody, by the tenor (Nachthelle) and contralto (Ständchen), each echoed beguilingly by the men's chorus all the way through, a long line of exquisitely varied harmonies, enchantingly shifting, as only Schubert could contrive. Leo Goeke—

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definitely he—is quite lovely as the tenor, Joy Blackett sings a darkly eloquent contralto, reminiscent of Kathleen Ferrier, the great English singer of a generation back. The Brahms horns are moodily Romantic, as though from some deep forest glen, the harp sound is unusual for him. The ladies chorus waxes and wanes with enthusiasm. Nothing lax in the chorus on this side. It's Waldman-style music.

Recording is somewhat uneven, with an overall low level in which unexpected peaks may overload your equipment, if you have turned it up.

Performances: B-, B+ Sound: B-

Tchaikovsky: Suite No. 3 in G. Moscow Philharmonic. Kondrashin. **Melodiya Angel SR 40175**, stereo, \$5.98.

Surprising to hear so much unfamiliar orchestral Tchaikovsky as appears in this robust Suite, composed in the ten-year period that elapsed between the Fourth and Fifth Symphonies. Most of us at least recognize major portions of the big scores Tchaikovsky wrote for the Russian ballet, long as they are, and every one of the six symphonies is reasonably familiar to most listeners at least here and there. Why not the Suites? What, indeed, is a Suite when Tchaikovsky writes one? Surely no relation to those of Handel or Bach!

Definitely not. In the Nineteenth century, the orchestral Suite was one of those titles you used when you wanted to avoid the formality and dress-clothes conventions of the Symphony, just as the Concertino or Rhapsody title avoided the formal Concerto. (Unless, of course, you wrote what you happened to feel like and brashly called it Symphony. Plenty did.) This particular Suite, in fact, began with sketches for a Symphony. The name changed when the music didn't shape up to then obligatory (for Tchaikovsky) symphonic dimensions.

How could you tell? I can only suggest that, first, the Suite music is more lyric, more melodic, less grandiloquent and less intense, than the corresponding Tchaikovsky symphony style. Who can complain about that? Not that it is any smaller in size. A big orchestra, and plenty of length. Second, the movements are less heroically contrasted. The first isn't as big and pompous as the traditional Tchaikovsky symphonic opener. The second is a "melancholy waltz," quite long. The third is a Mendelssohnian scherzo that would adorn any symphony. The last, all out of size and as long as all the rest put together, is the well-known

Theme and Variations in G, on which Balanchine based a ballet. This is the only portion which at least 95 per cent of listeners will recognize as familiar music.

Why are the suites so seldom heard? One of those "live" concert mysteries, having to do with past tastes and, probably, with such vital matters as easy score availability, plus the inevitable rule of caution that tends to concentrate the familiar repertory—let's not play *that*, let's play something everybody knows. And so a whale of a lot of worthwhile music is lost. Thank Heaven for the LP record. It alone has broken the back of such thinking in the classical field! "Live" concerts are far, far behind as any statistical breakdown will show. (cf. BMI's rosters of concert performance in the U.S.).

This performance? Highly to be recommended. Once again, the Russians seem to put verve and enthusiasm into their own music, here in an old-fashioned work just as they do in their stirring performances of Stravinsky and Prokofiev. The sound? A tiny bit scratchy in the loud string parts.

Performance: A- Sound: B-

Rossini: William Tell—Highlights. Guiot, Gedda, Blanc; Paris Opera Orchestra, Lombard. **Seraphim S-260181**, stereo, \$2.98.

Curiously, there seems to be no complete recording of William Tell, Rossini's last, greatest and most robust opera, except the Italian Carteri version put out by Everest. Maybe you should blame the Lone Ranger. (Kid comes in while I'm playing the Overture; "Hey, that's my favorite music, from the Lone Ranger!") Who ever hears the entire opera?

It was *the* Rossini opera in the 19th century. Almost a thousand performances by the time opera-on-records came to maturity on 78 electrical discs. The Lone Ranger took over soon after, as we all remember. I found I had not heard a note of this music, beyond the end of the Overture, the one ultra-familiar part. At least I know the whole of the Overture, not just the Lone Ranger episode!

William Tell is a true French opera, composed in French, in France, for a French company. This highlighted performance is French, in French, and it is terrific! Rip-roaring enthusiasm, dashing vocal technique—Nicolai Gedda is fantastic in the tenor role, which goes so high most tenors are afraid to sing it. Might blow a vocal fuse. I've often noticed that French

opera production gets panned regularly by the live-music critics and in truth is probably pretty bad from day to day in routine performance; but once the French companies get before the mikes, they come to life—and they positively scintillate. I remember an ancient mono Carmen, on Columbia. Best version I know (though utterly unlike the U.S./International Carmens we mostly hear). Same with a Faust. Terrific.

Too bad we have only highlights. I could listen to this French performance (yes—Gedda isn't French, but the performance *is*) for hours on end. Peppy, loud, disciplined, wide-open, and all-out, it makes wonderful listening. You'll hear opera on the very edge of Romanticism, the earlier Mozart-like style of music (Barber of Seville, etc.) just breaking forth into great, big Romantic sobbs. It would be corny if it weren't so good.

Performance: A- Sound: A-

Sibelius: Kullervo, Op. 7. Raili Kostia, sop., Usko Viitanen, bar., Helsinki Univ. Men's Choir, Bournemouth Symphony Orch., Paavo Berglund. **Angel SB 3778** (2 disks), stereo, \$11.96.

A crackerjack album, this one! Surprise, surprise. The big work, for two soloists, men's chorus and orchestra and occupying three of the four LP sides, is an early Sibelius opus and his first major attempt at large-scale music; it is so early, indeed, that he forbade its repeat until after his death, and thus it remained virtually unknown until the 1960s. Could be a big bore—a huge piece by an ambitious, all-out youngster. Far from it. The highly dramatic use of the men's chorus and the two soloists easily makes up for any diffuseness of form and content, of which there is, to be sure, quite a bit. I found myself generally fascinated by the combination, a musical format that Sibelius abandoned later in favor of purely separate works as symphonies, pieces for men's chorus, works for solo voices.

The story is typical Sibelius, which means typical Finnish-epic stuff, tinged with a Germanic vastness. Hero picks up gal on his fancy winter sledge, plants her under bear rugs or something and (presumably) does her in. Hero finds out she is his long-lost sister. Incest! Hero falls on his sword, at great (musical) length. End of Hero. But the method of telling is interesting. Instead of a narrator, or an endlessly singing tale-teller, Sibelius uses his favorite men's chorus, singing mostly in unison, to reel off the basic tale. He allows the soloists to sing only the high points

(if at length). Nice dramatic contrast, but what really caught me was the extraordinary rhythm of the Finnish poetry, as set by the composer. Masterfully done, and superbly sung by present-day students who are the successors of the same students, from the same University, who sang Sibelius in his own day and this work, if I am right, in 1892. The Finnish language has a curious lilt to it, a very striking way of ending sentences with two or three weak accents, rather slowly, as though we

were to say "The boy stood on the burning *top—most—deck*, whence all but he had *quick—ly—fled*." This, as one follows the (easily-followed) printed text, adds a really unique quality to the long men's-voice passages herein. By contrast, the soloists just sing, very competently, of course, but more conventionally.

A high spirited performance all around, sparked by the students and by the felicitous occasion, a combo of forces from British and Finnish sources

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(Continued from page 14)

NARAS people were not acting in any official capacity, but the many record producers in the audience wanted an opportunity to hear for themselves how far the industry has come on the development of a four-channel stereo disc and from two opposing viewpoints. CBS demonstrated their system first and it was very well received. At this point we must point out that most people consider that CBS has a particular advantage in controlling its own software. Indeed, just days previous to the NARAS meeting, Columbia broke with big ads, announcing the release of some twenty "SQ" discs, featuring their big names like Streisand, Blood, Sweat and Tears, Bernstein, etc. They promised 30 more discs by January of next year. So Columbia demonstrated, in much the same fashion as I related they had done in London. They played the system with and without their logic, and A-B the master discrete tape versus the "SQ" disc. Now comes on Electro-Voice, and President Larry LeKashman drops a bombshell . . . he announces that there is to be a new E-V IC which will play E-V encoded discs but which will also decode the previously "incompatible" "SQ" Columbia discs! Further, it will accomplish this automatically, with no user switching from one matrix to the other necessary. The complexity of the new IC can be judged from the fact that it contains in excess of 80 transistors and 100 other passive components. Then came the E-V demonstration in which they employed their new logic circuitry. This too was a surprise to many people and it was as well received as the Columbia demonstration. Differences between the two systems, lay in the direction of left/right separation and front to rear separation. With the usual oversized studio premises, a thorough evaluation was not practical. I personally will not venture an opinion of which is my choice until I have set both systems up in my home and have listened at length. In any case, in a certain sense we are closer to resolving the matrix situation, with the available software from two disparate sources playable on a "universal" decoder. One thing was conspicuous by its absence in both the CBS and E-V demonstrations . . . nobody played any four-channel matrix discs with *ambient* information. This to me is still going to be an eye-opener and may give a better insight as to the worth of the competing systems than anything else.

Note from the Editor: I have both systems in my home and will publish an evaluation in the next issue. **AE**

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AUDIO • DECEMBER 1971

THE WONDER OF THE AGE:

Mr. Edison's New Talking Phonograph

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sound my throne.
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The Gramophone."*

Edison deluxe model,
circa 1910.



George W. Tillett

MANY PEOPLE are under the impression that the disc record did not appear until long after the cylinder. This is not true; the fact is Emil Berliner demonstrated a hand-cranked disc machine way back in 1888! This event took place at the Franklin Institute in Philadelphia, and the machine was called a gramophone (a name still used by the conservative British).

The following year, Berliner took his invention to Germany where it was eventually produced by a prominent toy maker. This version played five-inch discs at a speed of 150 rpm. By 1898 both types, disc and cylinder, had improved so much that the demand was sufficient to bring down the price to reasonable levels. In that year, the famous Gramophone Company was founded in England. The great phonograph boom had started. In the words of Edison (or his publicity agent), "This tongueless, toothless instrument without larynx or pharynx, mimics your tones, speaks with your voice, utters your words; and centuries after you have crumbled into dust may repeat every idle thought, every fine fancy, every vain word that you choose to whisper against the thin iron diaphragm." And so celebrities of all kinds, the famous and not-so-famous almost fell over themselves to record something for posterity.

Kevin Daly has included many of these in his two Argo records (Argo ZPR 122/3) which he calls "The story of sound recording 1877-1925, compiled from contemporary writings and illustrated by archive recordings." I should mention here that they were made in England (which is probably appropriate). And so we hear the voices of Edison, Florence Nightingale, Caruso, Melba, Patti, and many more personalities of long ago. Bernard Shaw, who describes himself as "an amiable old gentleman of 71, with a rather pleasant voice," says "Let me give you a word of warning, you think you are hearing my voice but unless you know how to use your gramophone properly, what you are hearing may be grotesquely unlike anything that has ever come from my lips." The old gentleman's voice did indeed sound rather pleasant with its soft mellifluous

The Wonder of the Age: Mr. Edison's New Talking Phonograph, Argo ZPR 122/3, two discs, \$11.90.

AUDIO • DECEMBER 1971

Irish accent, so I presume my "gramophone" must be adjusted properly!

Not only do we hear the voices from the past but we are regaled with letters from contemporary newspapers, details of patent fights, exotica like the gas shell bombardment of Lille, 1918, a visit to a record factory and extracts from various advertisements. Some of these are very amusing . . . "The ideal phonograph table can be raised or lowered, will assist reproduction by giving a clear, solid tone." Or "Excelsior needles, the loudest shilling needle on the market." And how about the rather diffident, "Everyone will sooner or later have a phonograph as a necessity. Have yours now and enjoy it longer."

The narrative, spoken by five people is, in general, done very well—although I will concede that the meticulous British accents might irritate some people. In a project of this kind, there are bound to be some omissions and I was particularly disappointed to note that no mention was made of Percy Wilson although there were several quotations from the "Gramophone" with which he was associated for so many years.



Emil Berliner at 78.

73

Weingarten Looks At Mark-Almond

Sherwood L. Weingarten

DECEMBER is a month of retrospect, a time to pick out the highlights of a year gone all too swiftly. And, perhaps, a month of hope, a time ahead with a wish that man might, somehow, learn to live in peace with his neighbors. More mundanely, it is also a time for that annual parlor game, "Let's pick the best."

When selecting the top disc of 1971, it would be expected that the choice would be extremely difficult. Not so. In fact, I can't recall a 12-month span in which making a choice was an easier task. The winner, sound and fury above all others, is **MARK-ALMOND** (Blue Thumb, 8828), an album on which *everything* jells.

The LP contains but five cuts, all but "Song For You" (penned by Rodger Sutton) written by co-leader Jon Mark. He, not incidentally, is a young man who comes equipped with classical and electric guitars, second bass, percussion, and a lead voice that is rough 'n' tumble and sounds as if it stems from the raspy-throated, ghetto-worn body of a Black man despite the fact that Mark is white.

The mainstay of the quartet, however, is the other co-leader, Johnny Almond, another guy from the British side of the pond and one who is even better, in my opinion, than Paul Desmond was when the Dave Brubeck group was in its heyday. Almond, in fact, at times makes his sax (on "Love") sound like a Maynard Ferguson trumpet straight out of the Stan Kenton era; at other moments, his avant-garde riffs are a proverbial wonder to behold; at still others, his mellowness is something that cannot be equalled.

Almond, for the record, here is represented on baritone, tenor, alto, and soprano saxes, vibes, congas, and concert alto and bass flute. A one-man band? Not quite, but take away his many-faceted talent and the group could rapidly fade into obscurity.

Filling out the quartet are Tommy Eyre, who is highly skillful on concert piano, electric piano, organ, second flute, percussion, and second guitar, and Sutton, who romps on first bass, percussion, and performs the second-string vocals. Almond, Eyre, and Sutton all,

by the way, do vocal harmonies behind Mark.

The album, like so many superb ones in recent years, is difficult to categorize. The emphasis is on jazz-blues, of course, but there are threads of rock and pop, a pinch of gospel and a hint of classical strains. It all fits together so perfectly, though, that the pigeonhole doesn't matter; only the amazing professionalism and fantastic listening experience do.

The disc starts with "The Ghetto," with Mark singing his heart out. It is quickly obvious on the track, which is likely to be worn out from relistening, that he feels, feels, feels—and bleeds in full view of his audience. The piece begins with solo piano and then voice, with a vocal harmony (almost gospel) following; a cathedral-like sound succeeds, only to be surpassed by a sax and piano interlude that cannot be touched. The mournful vocal closes out what must be a meaningful experience (although, unfortunately, that phrase has become a cliché) for the listener.

Lyrics, too, are poignant and pointed: "New York City is where I come from," "Down in the ghetto, where you don't come. . . ."

"Nowhere to run, nowhere to hide; Just me and the ghetto, with you looking in from outside."

"And sometimes I get down on my knees; I wonder if He sees, I wonder if He sees."

The next selection, the trisegmented "The City," features a calypso beat and jazz, spurred by great sax riffs. The tune, which neatly meshes vocal and music, ends with heavy rhythm work.

The final track on Side One is "Tramp And The Young Girl," spotlighting vibes, vocal, and guitar, all of which again blend as if they were created as a whole instead of individually.

Flip side highlight is "Love," an 11:49 entry divided into four parts. Musically, guitar and flute initially lend a classical air; a breezy interlude is sharply Baroque in flavor. Pure jazz comes in then, reminiscent of the Modern Jazz Quartet (the stress is on vibes and bass). A piano segment is followed by a rock-

ish, screaming, soulful vocal, and then a melancholy sax takes over and wails, wails, wails. A harmonica sound atop a driving rhythm follows, with the vocal entering once more (this time softly). Somehow the whole thing floats away, as the idiom has it, *outsite*.

"Love," which may seem harsh at first, is not unlike a masterwork painting; each time you return to it, you find something new, a richer tone or a nuance that escaped your vision before. Perhaps it's a brighter musical hue, or a subtle movement you missed; it seems there's always something more, something extremely pleasing or tranquilizing.

Finally, Sutton's "Song For You" is a bluesy, slow-moving melody that despite being the worst cut on the LP is head and shoulders above most of the claptrap offered in today's pop marketplace.

It is rare that I *rave* about an album, although I do think there is much in the mod-ern music worth hearing (though sometimes I wonder if it's worth going through all the junk to find); this outing, far from leaving me speechless, makes me want to go on and on and on. . . .

HERE COMES THE SUN (RCA Victor, LSP-4536) finds Nina Simone with less quaver in her voice but more impact. Her most moving LP so far, it offers eight winners, best of which is the title tune. Other successes from the singer-pianist-composer are "Mr. Bojangles," "O-o-h Child," and "Just Like A Woman," a Bob Dylan tune which notes that "I ache just like a woman but I break just like a little girl."

PRISMS (United Artists, UAS 5511) has Oliver—known to his parents as William Oliver Swofford—offering good variety, with a folk emphasis and rock overtones. His pleasant voice, and the particularly human quality evoked by his slurring of "s" sounds, stands out on five of his own pieces, the Gibb boys' "Man For All Season," Steve Stills' "For What It's Worth," Gordon Lightfoot's "Early Morning Rain," and a medley.

WINDS OF CHANGE (London "Phase 4 Stereo," SP 44152) finds the Olive Branch recreating so-called now songs so the older generation can dig the music and meaningful lyrics. Smooth harmony is the keynote of the group's 10 tunes, best of which are the Joni Mitchell hit "Both Sides Now," Pete Seeger's "Where Have All The Flowers Gone," Simon & Garfunkel's "Bridge Over Troubled Water," and the traditional "All My Trials."

SUMMERTIME (A&M, SP4314) is the best album Herb Alpert has made with the nontouring Tijuana Brass. It

includes two hit singles, "Jerusalem," and the title number, as well as Lightfoot's "If You Could Read My Mind," featuring great interplay between Alpert's horn and a guitar, and "Catch A Falling Star," the antique Perry Como hit here revitalized by transforming it into a lullaby that is smooth, soft, and lovely (and aided by Alpert's brief vocal at the end).

PETER ALLEN (Metromedia, KMD 1042) is a newcomer, a guy with a high-pitched folksy voice who does his own thing and own tunes via vocal cords and piano. All are introspective and create a composite picture of the man. Best are the lead piece, "Honest Queen," and "What Difference Does It Make."

I JUST CAN'T STOP LOVING YOU (Ranwood, R 8085) spotlights Bill Justis' arrangements of The Exotic Guitars. Al Casey, lead guitarist, deserves attention, though the overall sound is probably best as a conversation background. Highlights include Simon & Garfunkel's "El Condor Pasa," George Harrison's "My Sweet Lord," Bobby Russell's "Honey," and the traditional "Hava Nagila."

THE YIDDISH DREAM (Vanguard, VSD 715-16) is a two-disc anthology subtitled "A heritage of Jewish song." Hershel Bernardi, Jan Peerce, Martha Schlamme, and others sing 25 numbers that are strictly for the ethnic crowd. Two "Fiddler On The Roof" tunes are included—in Yiddish, however.

CHEECH AND CHONG (Ode, SP 77010, distributed by A&M) are two guys in search of laughter via what they call "hard rock comedy." They spoof blind blues singers, rock festivals, grass smoking, drug use in Vietnam, morals charges and court justice, emergency ward delays, Christ (who's regarded as a hippie in a bit located in Mexico), Papal requirements, and late night movies and commercials. Nothing, obviously, is sacred, and there are enough purple words to keep the prudes away. But it is frequently funny stuff.

REVOLTING (Fantasy, 7016) is another of the new vogue comedy outings, this time by Richard Rollins and Howard Keer, who go under the joint moniker "The Congress of Wonders." Sex humor and mild obscenity dot the LP, which strikes out at idiot shows, the drug culture, newscasts, and anarchists.

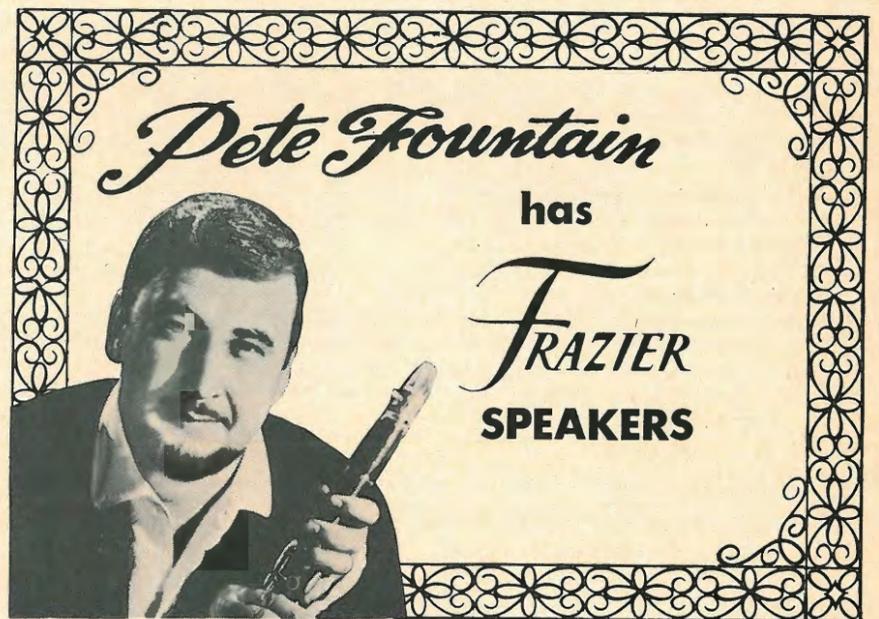
I FOUND ME A WHITE MAN, YOU FIND YOURSELF ONE! (Roulette, SR 42065) also puts stress on religion, sex, and ethnic gags, most of them blatant. Steve Rossi and his new partner, Slappy White (who replaced Marty Allen), stick to old schticks, however, aiming at those who prefer nightclub type of humor. The canned hysteria

is the only mar to a listener being captivated by the string of one-liners.

WAR WAR WAR (Vanguard, VSD 79315) shows that Country Joe McDonald, sans Fish, remains one of the most talented anti-war performers around, a male counterpart to Joan Baez. This outing contains nine songs composed by McDonald using lyrics extracted from poems by Robert W. Service. Best by McDonald, whose gristly voice fits neatly into the folk idiom, are "The Call" (which asks women to look their last on their loved

ones as the call of war comes), "War Widow," "The Twins," and "Forward."

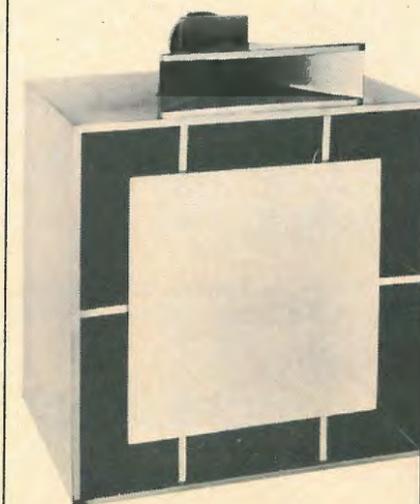
ELVIS—THE OTHER SIDES—WORLDWIDE GOLD AWARD HITS, VOL. 2 (RCA Victor, LPM 6402) is a compendium of 50 cuts, the flip sides of Presley's gold singles. The package, which also contains a swatch of material from the singer's wardrobe and a full-color pullout portrait of him, spotlights "King Creole," "Mean Woman Blues," "Puppet On A String," "Poor Boy," "There Goes My Everything," and "Witchcraft." **AE**



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(Continued from page 28)

physicist would say simply that you can't make a phone that will work well in these circumstances. But the engineer, by judicious employment of felt, foam, plastic, and wire, and despite humps and suckouts in the mid-range, smooths the response, struggles to get widest range and finally achieves a pleasing musical balance by minimizing the weak energy in the first three octaves and the effects of too much mass roll-off of the high end.

Pressure Type Phone

The ideal environment for propagating bass sounds is a closed cavity. Here the pressure mode of operation excels, for the circum-aural cushion seals the headphone diaphragm against the cavity of the ear. It can be predicted that response will be flat below the 400 or 500 Hz primary resonance of the system. Under these conditions we achieve linear response all the way to dc. This is a situation that can be used to help in other ways. The diaphragm can be much stiffer than in velocity phones, promoting an extension of the high end. The stiffness of 2 mil mylar, for instance, offsets the high frequency limiting mass of the material to give full energy level as high as 24 kHz.

The Glitch

We mentioned earlier that the reflection from the rim often causes a cancellation, the frequency of which depends on the diameter. This cancellation can be especially violent in a closed cavity. Referring to our chart of analogies, we find that acoustic resistance in the form of foam can eliminate peaks simply by knocking them off, or lowering the Q of the circuit. It can and does lower efficiency, too. Cone drivers common to lower cost headphones have bass efficiency to spare, but the acoustical resistance is difficult to apply, so most low cost headphones have a violent dip, or glitch, an octave or more wide in the midrange. (See Fig. 6.) This causes a displeasing hollow sound. If the glitch is more than 12 dB deep, it causes an actual physical discomfort because the brain is overstrained to supply the missing frequencies. The cone has another serious deficiency too. Not only does the mass of the cone roll off the higher frequencies, but the compliance of the very large trapped air volume shunts the high frequencies to the acoustic ground, consisting of the hard bones around the head and the headphone case.

The Fix

By using a smaller, flatter diaphragm, say two inches in diameter and mount-

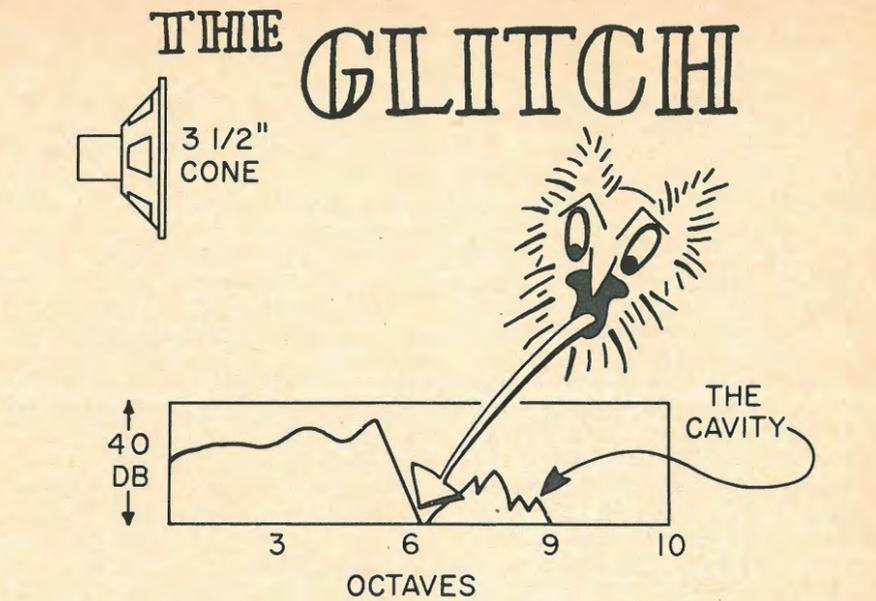


Fig. 6—The low energy output of cone type drivers is very high with a 3½-in. diameter cone, but is not easily damped. Operating as a pressure device in a sealed cavity, a violent cancellation is shown about 2000 Hz.

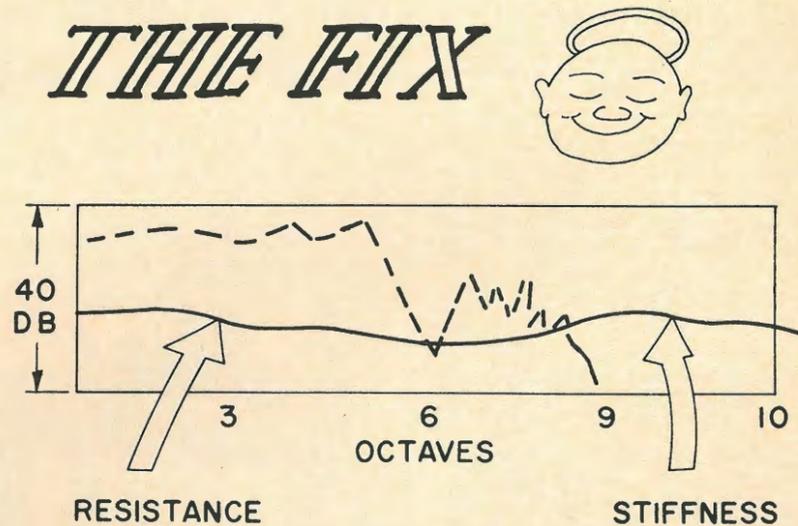


Fig. 7—With a 2-in. flat diaphragm acoustic resistance lowers the bass efficiency to the bottom of the "glitch." Increased stiffness and lower mass extends the high end.

ing it close to the ear, high frequency-destroying mass and compliance (the trapped air volume in the apex of the relatively large and heavy cone) can be reduced. This reduction gives ex-

tended highs at good efficiency. The diameter glitch is still there, however, and defies almost all countermeasures.

Instead of raising the bridge we must lower the river. Removal of the glitch

is accomplished at the expense of the unneeded bass efficiency by applying a very high acoustical resistance to the area back of but not touching the diaphragm. This works almost entirely at the low end to reduce all bass level to the bottom of the glitch, effectively banishing it. By compressing the felt used as a resistance the bass level can be adjusted for pleasing balance, or accented to appeal to the younger listeners. If physicists would only think of compromises like this there would be no need for engineers!

Exploiting the Pressure Design

The cutaway illustration of the new PRO-4AA headphone (Fig. 8) shows how the preceding considerations have resulted in a practical design which performs well. The felt washer is adjustably clamped to damp the bass range. A 1 inch very light weight self-supporting voice coil operates in a gap saturated with flux from the magnet structure. This coil is attached to a 2-mil mylar

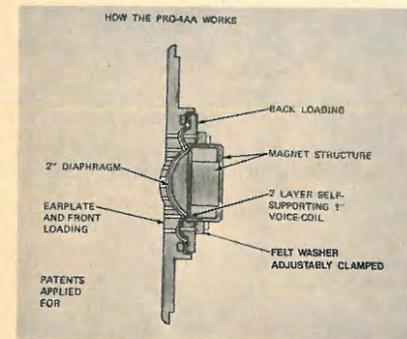


Fig. 8—Cross section of the Koss Pro-4AA with 2-in. element.

diaphragm that is actually sandwiched between 2 conforming plastic members. In this way high acoustical stiffness is achieved because the trapped air volumes are kept exceedingly small, thus giving extended 24 kHz response at full level. Note the plastic dome beneath the diaphragm which greatly minimizes the trapped air volume.

The conforming liquid filled ear cushion effects an almost perfect seal against the head with comfort, thus insuring linear bass response to the electrical limits of the supporting amplifier.

A collateral, but important benefit of the unique acoustical loading is that the plastic of the "sandwich" supports the mylar diaphragm uniformly against destructive excursions from all but the most severe overloads, making the element virtually blow-out proof.



STOP LOOKING and LISTEN

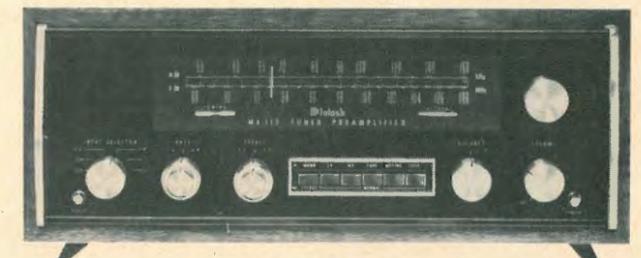
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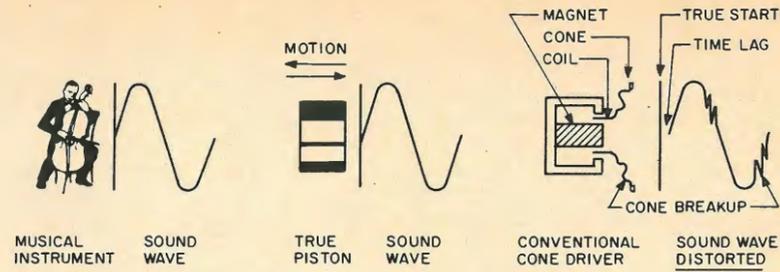


Fig. 9—Ideal piston operation and cone breakup.

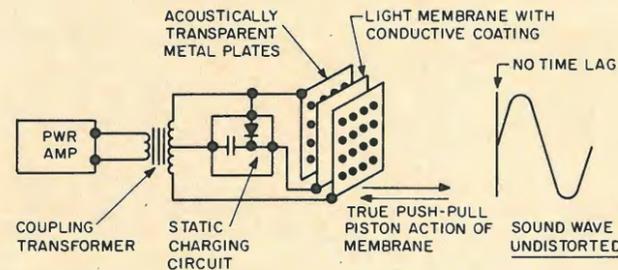


Fig. 10—Operation of the electrostatic driver. The charging circuit may be self-energized as shown, or be separately energized from a power supply, as with the Koss ESP-9.

ELECTROSTATICS

The illustration (Fig.9) shows a cone loudspeaker and an electrical signal in the form of pure sine wave. Lacking high stiffness, the cone vibrates not only at the frequency of excitation, but breaks up and vibrates at frequencies other than the fundamental. This is a form of distortion which is present in greater or lesser degree in all dynamic drivers because only the central portion of the cone adjacent to the voice coil is under perfect control.

In the search for flattest, most extended response range and lowest distortion, the electrostatic principle overcomes many disadvantages of the dynamic units and offers several important improvements.

The moving diaphragm can be very thin, say 1/2 mil mylar, weighing less than a 3/8 inch layer of air adjacent. While the ideal of "infinite stiffness" may seem distant, it is closer than we might first surmise.

In a dynamic driver the magnet structure provides an intense field. This field changes the condition of space around the voice coil so that current flowing through the coil causes it to move and transmit its motion, indirectly, to the diaphragm. In electrostatic transducers a static charge on the membrane also changes the condition of space. When the diaphragm is mounted between two acoustically transparent plates, the signal is impressed across the plates,

the entire diaphragm is electrically controlled, or stiffened, and force is exerted directly over the entire area, causing it to move without breakup as an ideal piston.

The resonance of the pressure operated electrostatic driver is in the region of 2 kHz because of its low mass. This means that below this point we predict, and obtain, virtually linear response. Aided by the high electrical stiffness as well as the low mass, extended high response is obtained, and attention to proper coupling to the ear results in excellent flatness. True push-pull action, not attained in dynamic designs, cancels all second harmonic distortion.

The effect of the performance of a good electrostatic headphone is immediate, vivid and compelling. The bio-acoustic benefits of very low distortion require study, but electrostatics have a cleanliness of reproduction not approached by any other form of reproducer. There is a satisfying, unstrained quality form the extended, flatter response that surveys an unparalleled emotional experience.

In electrostatic headphones we can find the happy blend of art and science. Try listening to them—and we think you'll agree that here is modern acoustical engineering in its highest, most sustained flight. **AE**

(1) *Journal of the SMPTE* Vol. 61, September, 1953, Physical Factors in Auditory Perspective, J.C. Stienberg and W.B. Snow.

Parts List, (Continued from page 40)

Capacitors			Quan.
Ref. Designation	Description	Part Number	
C1	30 pf, ±5%, mica		1
C2, C8	20 μf, 16V, electrolytic	Sprague "TL"	2
C3	22 pf, ±5%, mica		1
C4	1500 pf, ceramic disc		1
C5, C11	1 μf, 35V, tantalum	Sprague "196D" or Kemet "E"	2
Ct1a, Ct2a*	4700 pf, ±5%, mica		2
Ct1b, Ct2b	.047 μf, ±10%, 100V	Cornell Dubilier "WCR" polycarbonate	2
Ct1c, Ct2c	.47 μf, ±10%, 100V	As above	2
Ct1d, Ct2d	4.7 μf, ±20%, 10V	Sprague "196D" or Kemet "E"	2
Ct1e, Ct2e	47 μf, ±20%, 6V	As above	2
Ct1f, Ct2f	480 μf (330 μf and 150 μf in parallel for equivalent value), ±20%, 6V	As above	2
C6	500 μf, 25V, electrolytic	Sprague "TL"	1
C7	100 μf, 25V, electrolytic	As above	1
C9, C10	470 pf, ceramic disc		2
C12, C13	50 μf, 16V, electrolytic	Sprague "TL"	2
*See text.			
Semiconductors			Quan.
Ref. Designation	Description	Part Number	
D1 - D6	Silicon diode, gen. purpose	1N914	6
D7 - D10	Rectifier, 100V, 1A	1N4002	4
D11	Zener, 8.2V, 500 mw	1N5237	1
Q1 - Q4	Transistor, PNP	2N3906	4
Q5	Transistor, NPN	2N3567	1
Q6	Transistor, NPN	2N3904	1
Q7	Transistor, PNP power	2N4918	1
IC1	Op amp, uncompensated	National LM301A Fairchild μA301A Signetics N53A1	1
IC2	Balanced modulator	Motorola MC1496G Fairchild μA796C Signetics N5596K	1
IC3	4 transistor IC array	RCA CA3108	1
IC4	Quad 2 Input Nand Gate	Motorola MC7400P T.I. SN7400N Signetics N7400A	1
IC5, IC6	Monostable multivibrator	Motorola MC8601P	2
IC7, IC8	Dual JK flip-flop	Motorola MC 7473P T.I. SN7473 Signetics N7473A	2
IC9, IC10	Voltage regulator	Motorola MC1723CG Signetics N5723L Fairchild μA723C	2
Miscellaneous			Quan.
Ref. Designation	Description	Part Number	
T1	Power transformer, center tap, 117 V in, 25V out @ 1A	Stancor P8180 Triad F-45X	1
J1 - J4	Jack, BNC panel mount	UG-625	4
F1	Fuse, 0.5A, slow blow, with holder		1
P1	Line cord with plug		1
	IC socket, 14 pin, DIP style	Cinch 14 DIP	5
	Case, aluminum, grey hammetone	Bud SC-2130	1
	Control knobs, 1/4-in. shaft, to individual preference		8
	Circuit board, prepunched, with pins	"Vectorboard" 64P44/062EP	1

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Jazz & Blues



Martha Sanders Gilmore

Louis Armstrong: July 4, 1900/ July 6, 1971

Musicians: Louis Armstrong and His Orchestra; Louis Armstrong and His Hot Six; Louis Armstrong and His All Stars.

Songs: You'll Wish You'd Never Been Born; Hustlin' and Bustlin' For Baby; Honey, Don't You Love Me Anymore; Mississippi Basin; Dusky Stevedore; I Wonder Who; I Want a Little Girl; Fifty-Fifty Blues, plus 26 more.

RCA Victor VPM-6044, mono, two discs, \$11.96.

In a 70th birthday tribute to Louis Armstrong at the 1970 Newport Jazz Festival, speaking for a host of fellow trumpeters proudly gathered on-stage, Satchmo was graciously thanked by Dizzy Gillespie for his livelihood. And the slim-trim man-trumpet Miles Davis commented: "There is nothing that any horn player living today has done that Louis didn't do first." Limitless accolades have been heaped upon Armstrong and deservedly so. He has been lionized around the world as the amiable Ambassador of Good Will.

To listen to this two-record set commemorating Armstrong's life work, *July 4, 1900/July 6, 1971*, which spanned the very history of jazz, is an experience of peaceful joy. Satchmo projected a calmness, mellowness, surety, and above all happiness that infected everything with which he had contact. He was a kind of Santa Claus figure within the jazz world, spreading his gift of musical talent wherever he went. RCA Victor has gathered together no less than 34 sides out of a legacy of some 2500 recordings, which extend over three decades of the genius' work as trumpeter, singer, and entertainer, ranging in time from the early 30's to the mid-50's.

Although this is not Armstrong's greatest period artistically, since critics hail the classic Okes of 1928 as the epitome of his efforts, these LP's

reveal Satchmo's attributes and abilities in triplicate as singer, instrumentalist, and as the first of the great jazz soloists to plunge through the thicket of big band sound to liberate the soloist and pave a golden way for so many later musicians. No matter what Louis played, his excellence was never compromised or thwarted by his material. In his words, "A note's a note." He distilled the very essence of a song with his horn. His tone had a sheen like Georgian silver which has been passed down through generations.

Here, Louis both plays and sings on every cut, the theory being that his horn is an extension of his voice and vice-versa. Towering tone pinnacles, stalactites of sound, glistening notes, crystal clear, stripped down and streamlined icicles instilled with a warm vibrato which serves to give it all momentum, Louis prodding and pushing the beat like a goatherd.

Armstrong began his career as a child, singing for pennies on the streets of his hometown New Orleans. The booming bullfrogish intonations which are so familiar to us are less sandpaper in his earlier work. There is a bellowing roundness of tone in tunes from the 30's and 40's with his orchestra and always that Armstrong humor and chortling, guttural charm. His influence on a diverse group of singers is marked.

It can be said that Armstrong's earliest years were his noblest with the proof found in "You'll Wish You'd Never Been Born" where Louis plays an arresting trumpet flight intro. Satchel-mouth carries the band along gracefully and smoothly in "Hustlin' and Bustlin' For Baby," skimming the cream off the top and setting a bright, bustling pace. The orchestra smacks of mediocrity and achieves a muddy Guy Lombardoish, blender quality with innuendos of Vincent Lopez, but the sound reproduction in the early days of recording certainly has much to do

with how we hear it. Louis scats along as if to signal the band to take a chorus, then takes up his trumpet and blows with them.

Most of this is foot-tapping and even stomping music of the first order with a rinky-tink patchwork quilt effect generated by a generous dosage of stride piano and an astringent guitar which delineates the texture around the outer edges. It is a pity that RCA Victor did not go to the trouble of listing the personnel for newcomers to the idiom and an always new generation of listeners. It's nice to be able to identify these founding fathers of jazz.

"Honey, Don't You Love Me Anymore," 1933, is extremely interesting while "Mississippi Basin" is as stately and majestic as a bullfight, filled with swampy orchestral sighs and a steady shum-shum-shum in the rhythm section, an ingredient typical of the times.

That Louis lived up to his reputation of congeniality, good will, and overall sunniness is easily apparent in the rapport he strikes with the bands here. The listener gets a glimpse of Armstrong with three groups, which include His Orchestra, His Hot Six (New Orleans style), and His All Stars. The material is primarily popular songs of the 30's and 40's with a few blues sprinkled in—not outstanding musically for the most part but showcasing Louis most adequately. However, as these tunes indicate, they did have a feeling for lyric in those days.

"Dusky Stevedore" is wry and racy, the band running away with it, while "I Wonder Who" incorporates some pleasing ensemble work and points up Louis' faultless attack. A tuba is barely discernible in "Don't Play Me Cheap"—echoes of a past era—and "Linger in My Arms," 1946, is at last familiar.

Thelma Middleton sings on one cut, "No Variety Blues," followed quickly by Louis' rebuttal and we have some vocal duets with Jack Teagarten and

Louis in "Fifty-Fifty Blues" and "Please Stop Playing Those Blues, Boy." It is interesting to compare the timbres of the two very different voices. Teagarten, a member of Louis' Hot Six in the mid-forties, also plays trombone, emitting a lovely tawny tone that has all the shine of an apple. He is one of the few featured soloists here other than Armstrong himself and Barney Bigard on clarinet, who portrays the best of this now sadly neglected instrument.

Several of the sides were recorded during live concerts, taken from a Town Hall performance according to one source but not noted as such by RCA Victor. Thus, the reverberations and echo of a spacious hall are understandably evident in "Back O' Town Blues," Fats Waller's "Ain't Misbehavin'," from the Broadway show *Hot Chocolates* in which Louis played a role, and "Pennies from Heaven," from the film Louis made with Bing Crosby. The latter two tunes feature Louis' All Stars.

"Sugar" and "Endie" are fancy free and it is pleasant to hear "I Believe" and to discern the similarity in voice between Louis and the late Nat Cole. "A Song Was Born" remains a cheerful classic and delivers Dixieland ebullience and the entire effort is good medicine and calms the nerves.

Armstrong's staccato yet fluid phrasing both in his trumpet work and vocalizations is superb and precocious for his time. His flawless technique, harmonics, vast range, emotional intensity, and artistry are simply etched like gold on angel wings, perhaps Gabriel's. There is no excess, no clutter, only a purity and pristine beauty that could not be hampered with frill and artifice like the man himself, who changed not a whit even when playing for kings.

Don Miller has done an excellent job in remastering this formidable collection. In mono, the sound is surprisingly good when one considers the vintage.

To discover where our present-day giants of jazz derived their beginning, this is an ample source and more than returns the buyer's money. We only wish for a deserved documentation of personnel. To listen to this is serene joy!

Performance: B+ Sound: B+

Benny Goodman: Benny Goodman Today (recorded live in Stockholm).

Musicians: Benny Goodman and his orchestra.

Songs: Let's Dance; Sweet Georgia Brown; If I Had You; Baubles, Bangles,

and Beads; Stealin' Apples; I Would Do Most Anything For You; Turkish March (Venus HB); Sing, Sing, Sing; Goodbye; Don't Be That Way; Willow Weep For Me; Big John Special; Body and Soul; String of Pearls; Poor Butterfly; Dear Dave; Roll 'em; Blue Skies, and One O'Clock Jump.

London SPB 21, two vols., \$11.96.

Even the most scornful adversary of the jazz idiom should be won over and thereby converted upon hearing this joyous two-record set by that genial giant of the clarinet, Benny Goodman. This is music for any age. It bridges every gap, real or imagined. Issued by London, who thoughtfully and generously offers this double helping to the jazz buying public, the recording is a live concert which took place in Stockholm. Attended without question by a tremendous and ebullient audience, the recorded concert features no less than 20 tracks of Benny's bouncing style.

Goodman fans may recall former two-record sets: the ones recorded in Brussels and Russia, partially for reasons of diplomacy. But in this one, Benny is simply having a good time in Sweden, among a nation which views Swing as a permanent fixture in jazz evolution. Fact is, Goodman has influenced numerous Swedes to take up jazz clarinet so he is appropriately in his element here, and it shows!

Listening to this LP and comparing the Goodman of today with the King of Swing of the thirties is indeed a happy experience and complete pleasure. Understandably, the band has taken on a more modern approach through the years but without compromising its values. The material is the same—standards, popular songs, dance tunes—only the method of treatment has changed.

While lacking some of the slap-happiness and carefree quality of vintage Goodman, the overall style and attack is somewhat bolder and more daring, the arrangements carefully structured and executed with studied control with, one suspects, virtually no fear of the unexpected. And above all, it is quite evident that the orchestra is exceedingly well rehearsed and has fun playing together.

Unfortunately, the liner notes are insipidly vague and totally uninformative. They even neglect to detail the musicians, crucial in a record with the import of this one. Bear in mind, however, that there are 12 comely pages of photos.

Autobiographical sketches are drawn by Goodman in "Let's Dance" which sports three hats as concert opener, Benny's theme, and the title of his old radio show aired by NBC back in 1934.

Goodman's stints with small groups are obvious in a trilogy of old favorites which whisk us back to the swing era of the late thirties and early forties via combo. A rousing "Sweet Georgia Brown" gets the group off the ground, Benny leading off, cocksure, carefree, embellishing enthusiastically. Benny likes to make his entrance on high notes, then really let go and wail. The interplay here among Goodman, the guitarist, and pianist Bill McGuffie is a whirling success.

The old chestnut "If I Had You" is given a ballad treatment with King Benny descending with bravuro as if from a throne, exploring the lower register richly, fully. At times he seems to float along the crest of one note to the other. The bass is picked up well, walking punctually through the tune.

"Baubles, Bangles, and Beads" is a showcase for trumpeter John McLevy whose velvet tones and winsome sonority suggest the flügelhorn of Art Farmer and whose bleating staccato approach calls to mind at once Jonah Jones and in technique, Freddie Hubbard. But it is all McLevy!

"Stealin' Apples," a Fats Waller composition, orchestrated by the late Fletcher Henderson who, incidentally, did many of Goodman's arrangements, is a roaring success—an exercise in riffs and big band writing. Goodman's clarinet soars over the entire effort, incisively threading the needle in and about the musical threads.

The set is a well balanced blend of ballads and belters. Trumpeter Derrick Watkins displays all sorts of highs and all manner of technical ability in "Willow Weep for Me" in which he more than compensates for a not so perfect tone. "Willow" has a "blues in the night" feeling to it. Surprisingly, the band here sounds like Buddy Rich, the orchestra tripping into a 6/8 rhythm and taking a subtle bow to rock. All in all a charismatic chart complete with Beethovenesque ending! And wouldn't it be a treat to hear Goodman and Rich play together.

The comparison of Goodman's "Big John Special" of today with his 1938 version is indicative of the inevitable change the band has experienced over the years. The earlier version is more mellow, purer, faster, the musicians playing for the sheer fun of it and not trying so hard while the 1970 version is taken at a much slower tempo, spelling out its abilities and attributes to the listener. A Horace Henderson tune, "Big John Special," is dedicated to a favorite Harlem bartender. Such endearing music it is!

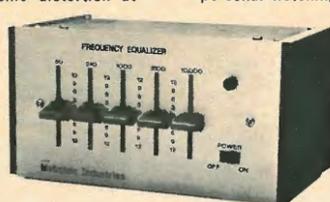
Although technical problems creep into "Body and Soul," a mite muddy in

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spots as if someone slowed down the record, Bob Burns redeems the effort on tenor saxophone, doing his solo to a fine turn. Goodman stretches out in "Poor Butterfly" at a loping tempo, his tone superb, while the guitarist seeks out the nooks and crannies, judiciously filling in the spaces.

"Dear Dave," written by pianist Bill McGuffie, is outstanding, a jewel in waltz time. It is pleasant to hear the sprinkle of notes from the piano, a kind of lace edging to the rich, mellifluous timbre of the orchestra. The piano is right out front; the brass nibbles at the keyboard phrases.

Goodman rolls 'em on Mary Lou Williams' "Roll 'Em," but we think it could have been taken faster. The tune was inspired by the boogie-woogie resurgence of the early thirties.

"Blue Skies" suffers from poor engineering in spots as if someone had turned the knob at the wrong time or broken a circuit, but Henderson's arrangement, the performance of the band, and utter beauty of the song itself overcomes all obstacles.

Here, as in times past, they resurrect "Sing, Sing, Sing" which we think should be let be as a magic moment in music during the thirties when musicians were turned on by one another and wanted to play on and on—a jam session in the true sense of the word and one of a kind. In Stockholm, Bobby Orr tries to drum it all back up and although his attempts are noble, tossing off some crackling rolls and thudding door slams, the tune doesn't make it. The entire 11 or so minutes lack unity and fulfillment.

A moving rendition of Gordon Jenkins' "Goodbye" ends the concert as in the old days, one of the loveliest songs ever written. Benny's lines are fluid, his tones rich and ample.

Except for a few minor technical flaws and a preponderance of recorded applause, London has engineered this well; the reproduction is crisp, the separation clear. Although the piano is not reproduced as well as it could be, the bass comes right through. And it is a pleasure to hear the warm tones and good humour of Goodman himself announcing the numbers.

Once again, Benny Goodman demonstrates the vital role he has played in the history of jazz. The first musician to integrate his orchestra (which he did in the thirties when Teddy Wilson was among his happy entourage), he continues to make jazz joyful and international, circulating countless keys to his musical kingdom. One would have to search far to find a more authentic and amiable ambassador to the musical world.

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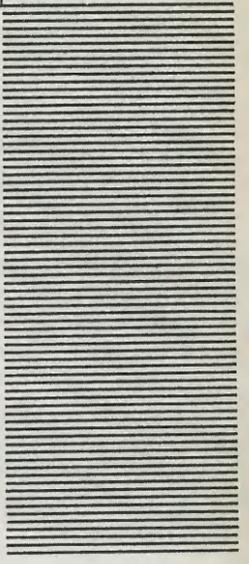
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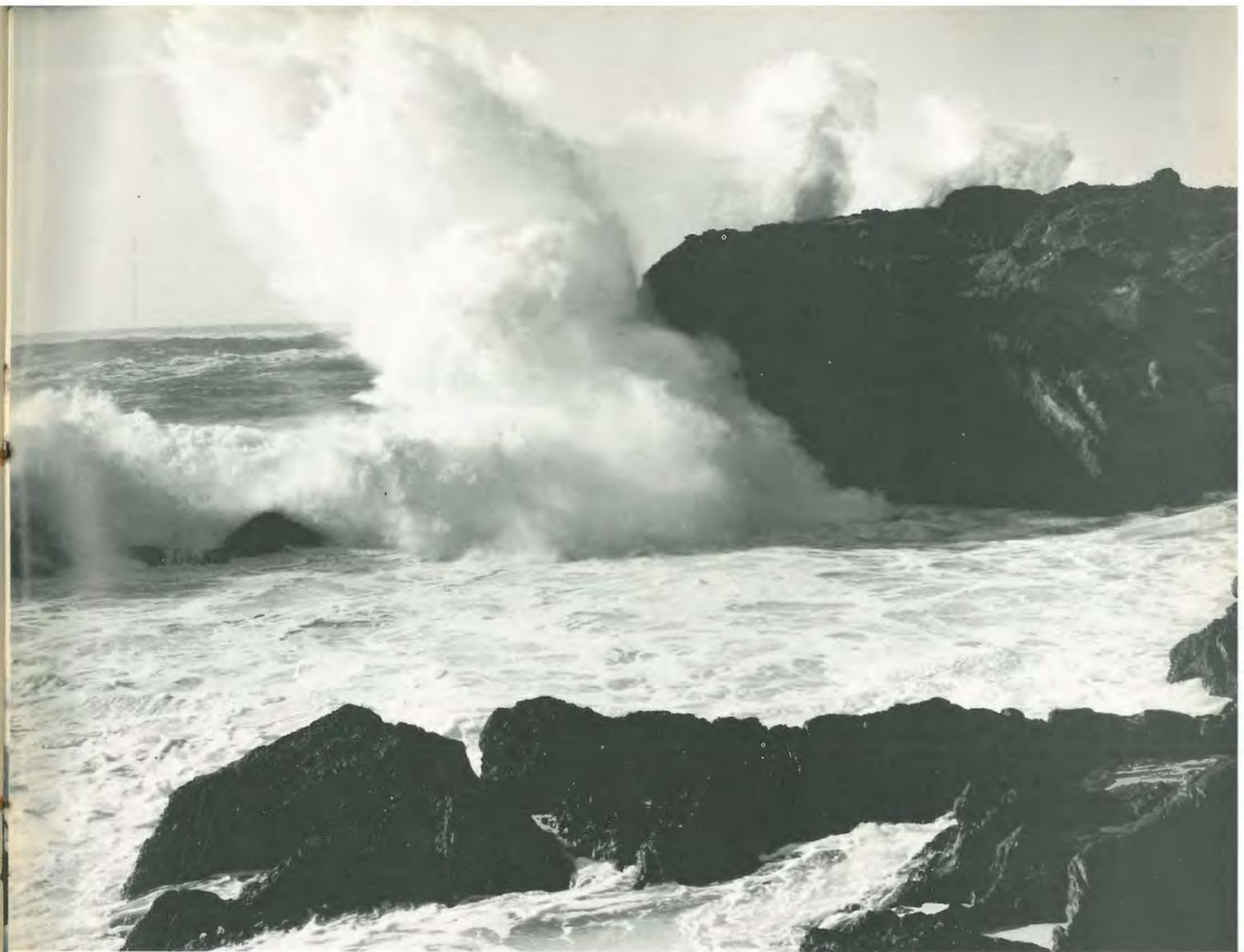
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Let's face it: most speakers look the same, most speakers have an impressive list of specifications and ALL-ALL-ALL speakers claim to be the very A-1 HOT SHOT MOSTEST BEST.

But the proof is in the listening. And that's where the Marantz Imperial 5 comes in. The Imperial 5 is engineered to handle a plethora of continuous RMS power and has an acoustic



suspension woofer and tweeter with a fantastic off-axis response and a 3-position high frequency control and costs just \$89 and gives you true stereo separation anywhere in the room and is, for the money, truly the very A-1 HOT SHOT MOSTEST BEST.

But on paper so is theirs. However keep this in mind. Marantz speaker systems are built by the makers of the most expensive stereo equipment in the world. And exactly the same quality that goes into Marantz receivers and Marantz amplifiers goes into the Marantz Imperial 5 speaker system.

To find out how much better it sounds, listen. That's all we ask. Listen. Then ask about the big savings on a complete Marantz system.

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