AES Convention Preview

The Authoritative Magazine About High Fidelity

AUDIO

MAY 1970

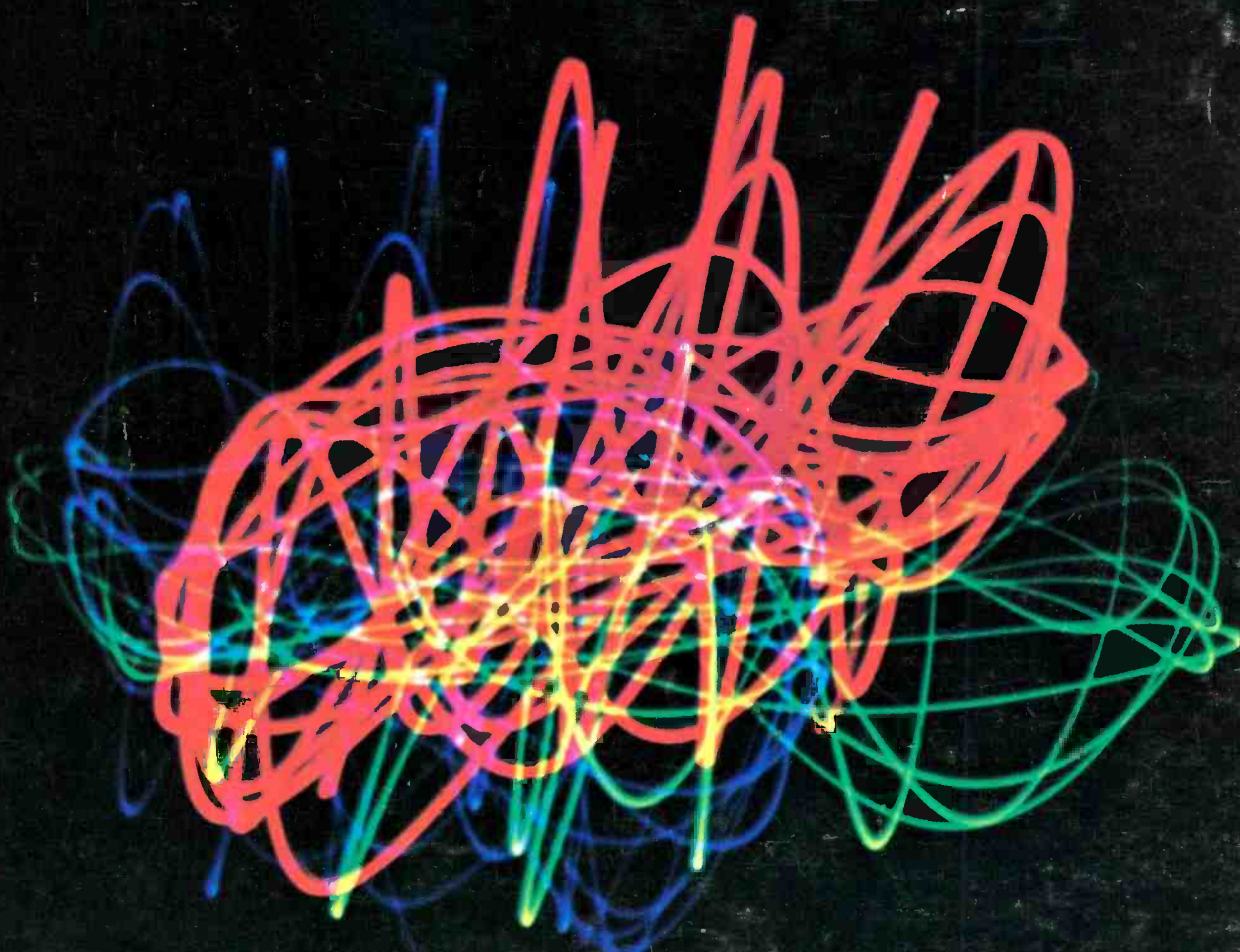
60¢

15 Channels on one pair of wires!

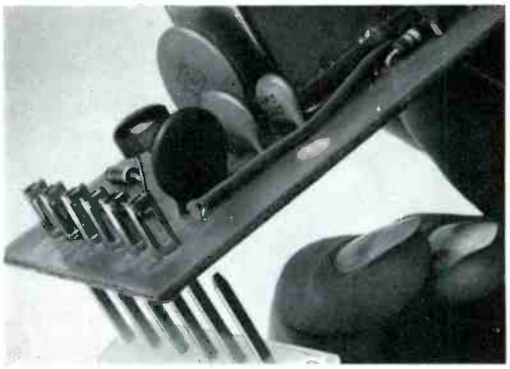
The Dolby System and Cassettes

A New Electronic Synthesizer

Record and Tape Reviews



This is a Plug for High Fidelity's Most Liberal Service Policy:



If any Scott Modutron printed circuit board ever needs service, we'll replace it . . . free during the two-year warranty period; and for only $10 thereafter

Let's face it . . . electronic devices are becoming progressively more complex, and therefore more difficult and costly to repair.

Scott engineers have solved this problem two ways. First, they minimized the need for service through careful selection of parts. Then, they went on to simplify servicing through use of replaceable Modutron circuit boards.

WHAT'S A MODUTRON CIRCUIT BOARD?

All major Scott electronic circuits are modularized on separate plug-in printed circuit boards. Each board plugs into place on the chassis. This means that a failure in any major circuit can be repaired instantly by plugging in a replacement board. Scott's new Modutron service policy allows replacement of any plug-in printed circuit board at deliberately low cost . . . no matter how long you've owned your unit!

HOW DOES THE MODUTRON EXCHANGE POLICY WORK?

If your Modutron unit ever needs servicing, here's all you do:

Take or ship your component to a Scott Warranty Service Station.

Your unit will be electronically tested and the problem isolated.

The warranty station will exchange the defective board for a perfect one right from stock, or contact Scott for air shipment.

Service is faster than ever before, and you pay only a nominal amount for trouble-shooting, any necessary alignment, and the standardized $10 exchange cost (or the equivalent in 1970 purchasing power) of a perfect factory-rebuilt Modutron circuit board, providing there has been no physical damage to the original board.

HOW DOES THIS AFFECT MY WARRANTY?

The Modutron exchange policy is a supplement to Scott's regular Two-Year warranty. During the first two years of ownership, there is no charge for either parts or labor costs. The Modutron exchange policy is additional protection . . . assuring you of continued service at minimal cost no matter how long you keep your Scott unit. Scott is proud of its long-standing policy of servicing its products regardless of age. Even today, Scott owners can bring in amplifiers they bought in 1947, Scott's first year of production, and receive prompt, complete service.

SCOTT AUDIO COMPONENT, LOUDSPEAKER SYSTEM, AND STEREO MUSIC SYSTEM WARRANTY

All H.H. Scott professional quality tuners, amplifiers, receivers, compact stereo music systems, and loudspeaker systems are warranted against defects in material and workmanship for two years from the date of sale to the consumer. The unit must be delivered to and picked up from either an authorized Scott warranty service station or the Customer Service Department, H.H. Scott, Inc., 117 Powdermill Road, Maynard, Massachusetts 01754.

This warranty covers repair and/or replacement of any part found by the manufacturer, or his agent, to be defective, including any associated labor cost.

The above warranty does not apply to (1) accessory parts explicitly covered by the field warranty of an original manufacturer (2) units subjected to accidental damage or misuse in violation of instructions; (3) normal wear and tear; (4) units repaired or altered by other than authorized service agencies; and (5) units with removed or defaced serial number.

HOW WILL THIS AFFECT FUTURE SERVICE COSTS?

The 1970 CONSUMERS GUIDE published by BUYERS GUIDE magazine says . . . "as for out-of warranty repairs, modular circuit design can cut service bills by 40-80% compared to what it costs to have a non-modular receiver repaired."

WHAT SCOTT UNITS ARE COVERED?

Most of Scott's new receivers, plus all Scott components presently under development, incorporate Modutron construction. Included are the 342C FM stereo receiver, the 382C AM/FM stereo receiver, the 386 high-power AM/FM stereo receiver, and the Scott 2506 compact stereo systems.

SCOTT®

H. H. Scott, Inc.
111 Powdermill Road, Maynard, Mass. 01754
Export: Scott International, Maynard, Mass. 01754

Check No. 100 on Reader Service Card

When you spend $395.00 each
on a speaker system for your home,
you expect to get
the same fine quality components
that are used in
"The Voice of the Theatre" systems
and now performing in most theatres,
recording studios and
concert halls in the nation
plus a wider angle of distribution
through mids and highs for clearer sounds
plus a smoother and flatter response
plus an unbounded dynamic range
plus a hand-rubbed-pecan-finished cabinet
plus a high-relief-decorator design
plus a lot of other things.

We don't think that's expecting too much.

Altec Lansing
full-size speaker systems
include the Milano
in pecan (shown), $395.00 each;
the Valencia in walnut, $339.00 each;
the Flamenco in oak $339.00 each.
Hear them perform at your
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Or write for a free catalog:
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Attn: A-5.

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A QUALITY COMPANY OF LTV LING ALTEC, INC.

AUDIO

Successor to RADIO, Est. 1917

MAY 1970 Vol. 54, No. 5

FEATURE ARTICLES

EQUIPMENT PROFILES

RECORD/TAPE PREVIEWS

AUDIO IN GENERAL

Coming in June

4-Channel Headphones—a description of new quadraphonic headphones that really work!

FM Tuner Alignment—Arthur Boynton tells you how to align your stereo tuner. Part 1 deals with FM generator modifications.

Transistor Oscillators—Norman Crowhurst writes about solid-state oscillator theory and practice.

Equipment Profiles will include:
Ferrograph Series 7 Tape Deck
Pioneer Reverb Unit
Electra Amplidyne SE-111 Equalizer

PLUS

Behind the Scenes with Bert Whyte and all the regular features, tape and record reviews.

About the cover: this shows a laser display on the dome of the Pepsi-Cola pavilion at Expo-70. A kyrpton laser beam is split into four colors and then modulated by sound impulses using special mirror galvanometers. The sound system itself uses 37 speakers ranged on a rhombic grid in the dome and sounds are switched vertically and laterally at differing speeds. Eight audio sources are employed with switching matrixes. The audio-visual systems were designed by Gordon Mumma and David Tudor, who are composers, in conjunction with Bell Labs and E.A.T. (Experiments in Art and Technology, New York). Believe it or not, the display shown was made by whales, yes, *whales* who are apparently to be seen somewhere in the pavilion! Probably swimming in Pepsi-Cola . . .

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To maintain the uncompromising standard of Garrard automatic turntables, we mass produce them.

By hand.

Garrard of England is the world's largest producer of component automatic turntables.

A mass producer, numerically speaking.

Especially curious, since Garrard remains a staunch foe of mass production methods.

At our Swindon works, final assembly of the Garrard SL95B is in the hands of nineteen men and women.

Hands, not machines.

A modest record

As Brian Mortimer, Director of Quality Assurance, sees it, "In top form they turn out twenty units an hour. A rather modest record in these days of mechanized production lines.

"But if we were to speed it up, we'd pay for it in quality. And, in my book, that's a bad bargain."

At Garrard, we insist that each person who assembles a part test that finished assembly. If it isn't up to standard, it's corrected on the spot—or set aside to be made right.

And then we test our tests.

Four of our nineteen final "assemblers" do nothing but testing.

Before each unit is packed in its carton, it must pass 26 final checks that cover every phase of its operation.

Is all this fussbudgetry really necessary?

Brian Mortimer answers it this way. "It would be sheer folly to give up the precision we'd achieved in manufacture through imprecise assembly."

The case for fussbudgetry

Of the 202 parts in a Garrard automatic turntable, we make all but a handful ourselves.

And we do it for just one reason. We can be more finicky that way.

For instance, in the manufacture of our Synchro-Lab motor we adhere to incredibly fine tolerances.

Bearings must meet a standard of plus or minus one ten-thousandth of an inch. Motor pulleys, the same.

To limit friction (and rumble) to the irreducible minimum we super finish each rotor shaft to *one microinch*.

And the finished rotor assembly is automatically balanced to within .0008 in.-oz. of the absolute.

So, in the words of Brian Mortimer, "We indulge our fussiness with a certain amount of conviction."

From Swindon, with love

For fifty years now Garrard has been important to the people of Swindon, and they to us.

Many of our employees are second and third generation. (Mortimer's father hand-built the first Garrard.)

And 256 of them have been with Garrard for more than 25 years.

We've been in good hands.

Today's SL95B is the most highly perfected automatic turntable you can buy, regardless of price.

Its revolutionary two-stage synchronous motor produces *unvarying* speed, and does it with an ultra-light turntable.

Its new counterweight adjustment screw lets you balance the tone arm to within a hundredth of a gram.

And its patented sliding weight anti-skating control is permanently accurate.

$44.50 to $129.50

There are six Garrard component models from the 40B at $44.50 to the SL95B (shown) at $129.50.

Garrard standards, nonetheless, do not vary with price. Only the degree of refinement possible.

The choice is yours. However, your dealer is prepared to help.

Garrard®
British Industries Co.

Check No. 3 on Reader Service Card

Audioclinic

JOSEPH GIOVANELLI

Power Line Considerations

Q. I am a foreign student. I am about to buy an FM stereo receiver. Because the household power in my country is 220 volts, 50 Hz, I would like to know if the use of a step-down transformer will in any way affect the performance of the receiver.

Is it O.K. to use the same step-down transformer to power the receiver and the turntable? Going a bit further, is it O.K. to use the same transformer to power my audio equipment and my household appliances? In other words, is it O.K. to use one big transformer for all my needs or is it better to use several smaller ones? E. de Weerth, Albany, Cal.

A. There is no reason why you cannot use a step-down transformer to obtain the voltage and current required to operate your equipment. Further, all devices you plan to use can operate from this same transformer. However, when doing this, the physical size of the transformer becomes quite large. Remember that the transformer must be capable of handling the total power used by all the devices which you plan to drive with this unit. For instance, household appliances, such as refrigerators and irons, consume quite a bit of power.

You must remember one more item. The receiver is designed for 117-volt operation, but at a frequency of 60 Hz. It will operate at 50 Hz, but the power transformer will become warmer than when operated at 60 Hz. Therefore, you need to be certain that the power transformer can withstand this added heat.

Phonograph and tape recorder motors are something else again. Their speed is not determined by the voltage applied to them, but is determined by the frequency of the power source. Hence, a motor designed for 60-Hz operation will run slower when supplied with 50-Hz energy than it will when it is operated at its design frequency of 60 Hz. Therefore, you will need either a new motor or you will need some kind of pulley adaptors which will result in correct operation of the equipment. Many tape recorders and phonographs are so arranged that they can accommodate such pulleys.

Hence, you see that there is no problem about the use of the step-down transformer. Whether you use one large one or several smaller transformers will be a matter of what you can obtain rather than other considerations. Remember that motors which must operate at precise speeds will have to be modified in order to compensate for the frequency difference between 60 and 50 Hz.

Electrostatic Speakers

Q. I am considering the purchase of a full-range electrostatic speaker.

I am most anxious to have the following questions answered.

1. Do electrostatic speakers "wear out?"

2. Does weather affect the operation of these speakers or cause deterioration of them?

3. Do the high-voltage transformers used with these speakers fail?

4. Do these speakers require any type of maintenance?

5. Any other information regarding electrostatic speakers. Don R. Parman, La Canada, Cal.

A. 1. Any speaker can fail after a period of operation. Electrostatic speakers are quite delicate. If they are fed with too much power, there is danger that the diaphragm will come into contact with the outside screens. This will result in an arc which will ruin the diaphragm. Also, if the diaphragm material was not prestretched, it could gradually sag and be attracted toward the screens and thus be ruined by arcing. However, I have heard from people who own these speakers that they just continue to operate very well over the years.

2. I have heard of a few instances where high humidity has caused some arcing and unexplained sounds emanating from the speakers. However, this does not appear to be a common problem.

3. I have never heard of these speakers failing because of high-voltage-transformer breakdown.

4. There is nothing that the owner of an electrostatic speaker can do in the way of preventive maintenance. It is unlikely that you can make the necessary repairs in the event of a failure any more than you can make such repairs with a conventional speaker.

5. The one drawback which I have noticed about electrostatic speakers is that they cannot handle large sound levels. You might have to add an additional speaker to each channel to get the kind of volume that you want. If you are not interested in really loud sound, you have no problem at all. If the sound was loud enough for you, when you heard the electrostatic speakers for the first time, you should be able to buy them with assurance that you will enjoy them. I would imagine that if you heard these speakers in the typical dealer's showroom, that this room is larger than your living room. Thus, if the sound was sufficiently loud for you under these conditions, you should be happy with them in your smaller living room.

Stereo Cassette Player Problem

Q. I installed a stereo cassette player in my car which requires 3.2-ohm speakers. My problem arises, I think, from the two 8-ohm speakers that I mounted in the car doors. I was getting some distortion with this arrangement. High-pitched instruments sound unclear. An alto sax, for instance, sounded as if it needed to "clear its throat." Incidentally, the same tapes played on a home cassette unit sound fine.

I tried to compensate for this mismatch by adding a set of 8-ohm, four-inch speakers in parallel with the original set. These were mounted in the kick-panels. I believe this has eliminated the distortion. Now the sound is so shrill that with some recordings it is almost unbearable, even with the treble completely attenuated by the tone control.

Should an upward mismatch of 3.2 to 8 ohms produce distortion?

What would you suggest as a remedy other than the obvious substitution of a pair of 3.2-ohm speakers for the original 8-ohm units? David H. Sexton, M.D., Knoxville, Tennessee

A. Possibly you are now getting the shrill sound because the two additional speakers are more efficient than the original 8-ohm speakers you were using. Because these speakers are smaller, they will reproduce treble frequencies more efficiently than the original speakers. This would result in the shrillness. I am guessing, of course, that the original speakers are physically larger than those you added more recently. Otherwise it just might be that the added speakers are just "brighter" and more efficient all around than the original ones.

With the 8-ohm speakers running by themselves, it is likely that the amplifier

(Continued on page 69)

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.

What's New in Audio

Marantz 23 AM/FM Tuner

Features of Model 23 tuner include signal-strength and center-channel multipath meters, Gyro-Touch tuning mechanism, interstation muting and a black-out dial panel.
Price $259

Check No. 21 on Reader Service Card

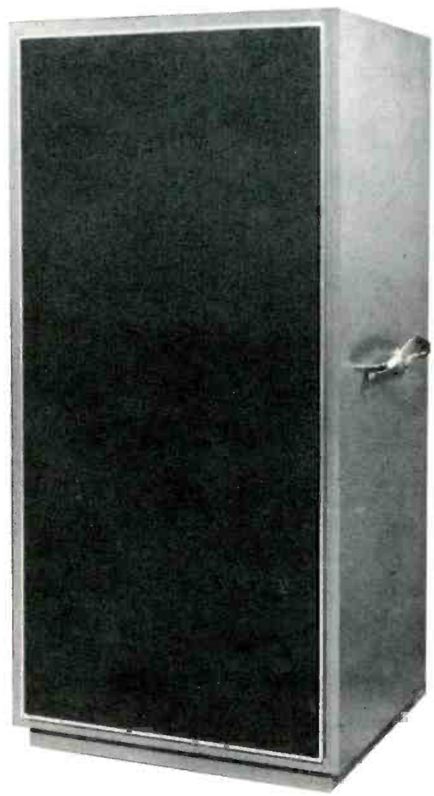
The Empire Grenadier 6000

A three-way system using a 10-inch bass unit, mid-range and treble direct radiators with acoustic lenses. Frequency response is stated to be 30 to 20,000 Hz and power handling capacity up to 75 watts. Height is 24⅜ inches with a diameter of 18 inches.
Price $99.95, with marble top $109.95

Check No. 23 on Reader Service Card

New IMF Monitor Speaker TLS Mk 2

This new system uses a 16 by 9½ inch bass unit with flat polystyrene diaphragm, a 5-inch mid-range speaker, a 1½-inch pressure unit plus a ½-inch dome unit for high frequencies. A transmission line is used to load the bass speaker and the mid-range unit has a similar termination.



Power handling capacity is quoted as 100 watts rms and the frequency range within 3 dB from 30 Hz to 28 kHz. Dimensions 41 inches high, 20 inches wide, by 17 inches deep.
Price $660 in Formica. Domestic versions available in rosewood

Check No. 20 on Reader Service Card

Catalogues

Lafayette has a new brochure covering recorded stereo tapes, 8-track, reel-to-reel and cassettes.

Check No. 28 on Reader Service Card

Koss are now offering an easy reference brochure describing their range of stereo earphones and ancillary equipment.

Check No. 34 on Reader Service Card

Abphot Analog Voltmeter

Model 1001 is a precision voltmeter with a FSD of 300 microvolts to 100 volts in 12 ranges. Input impedance is 1 megohm and frequency range is 10 Hz to 1 MHz. It is battery operated and the scale on the meter is 4½ inches long. Five notch filters are available covering frequencies from 400Hz to 15kHz enabling distortion measurements to be made.
Price $160

Check No. 24 on Reader Service Card

Scott Quadrant Speaker

This is a new low-priced version of the original Q-101 system. It uses one woofer and three tweeters which are placed on three of the cabinet's four sides so there are both directive and reflective sound. The bass unit is an 8-inch type and the tweeters are 3 inch. Power handling capacity is quoted as 35 watts with minimum requirements of 7 watts. Dimensions 10 x 19 x 10½ inches.
Price $89.95 each

Check No. 22 on Reader Service Card

Ampex Microphone

Model 244 is an omni-directional dynamic microphone which recently received an award for design excellence from *Industrial Design Magazine* and was formerly sold only with Ampex cassette recorders.
Price $7.95

Check No. 40 on Reader Service Card

The Super Natural from JVC

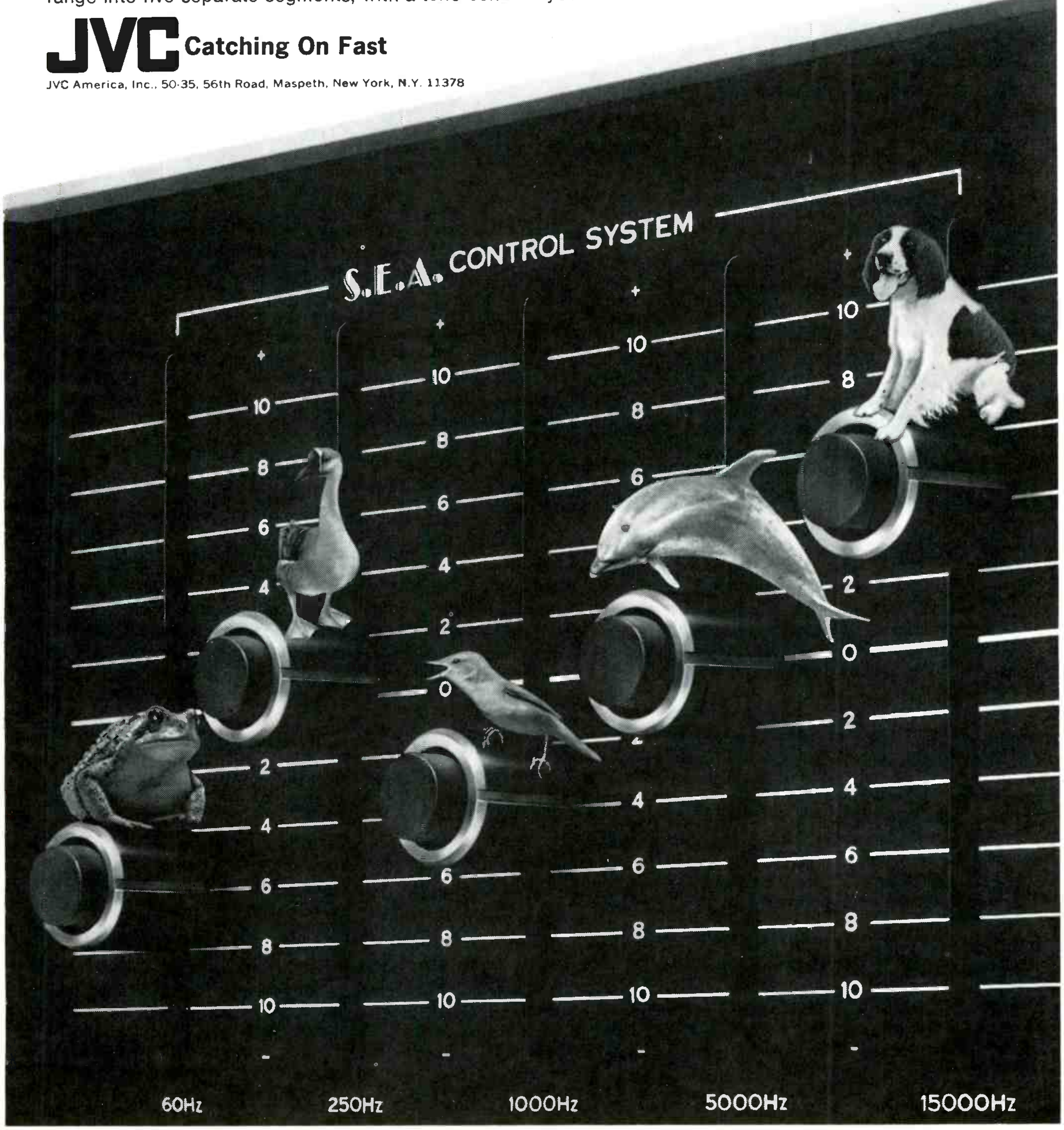
Now, JVC brings you Super Natural Sound: From a bull frog's croak to a Beethoven Symphony, you can enjoy stereo so true to life that it's hard to tell from the real thing. All made possible by a revolutionary new development—a JVC exclusive—called the Sound Effect Amplifier (SEA), shown below. And SEA is just one of many great advanced features that you will find built right into JVC's 5001, 5003, and 5040 AM/FM stereo receivers, without extra charge.

SEA actually divides up the audio frequency range into five separate segments, with a tone control for each. So you can boost or decrease bass, middle ranges and ultra-high's, mix and match sounds, just like in a studio. And, you can compensate for component characteristics, balance acoustics of any room.

SEA stereo receivers also have the latest IC and FET circuitry. Extra-wide bandwidths, low distortion and excellent S/N ratios. Listen to them today at your local JVC dealer. Or write us direct for color brochure and the name of your nearest dealer.

JVC Catching On Fast

JVC America, Inc., 50-35, 56th Road, Maspeth, New York, N.Y. 11378



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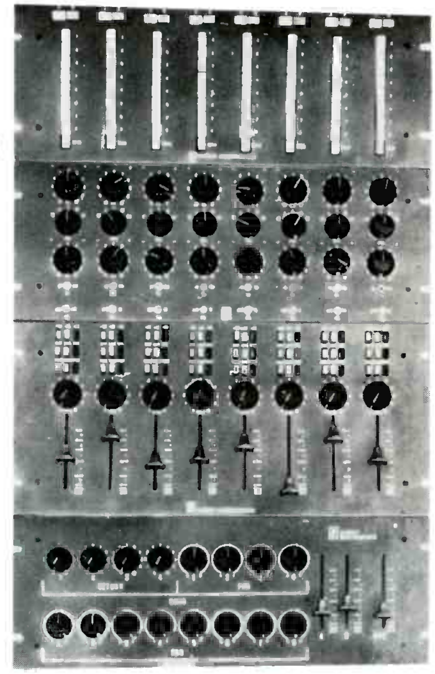
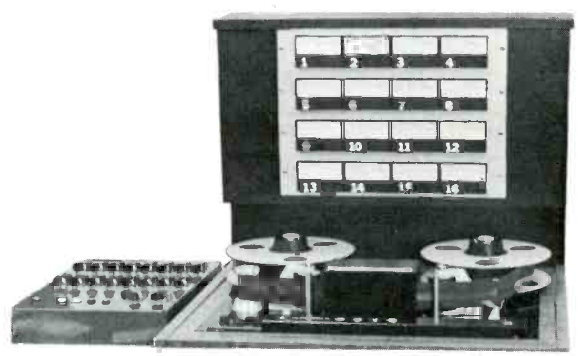
AES Preview ..

Norelco custom mixer console

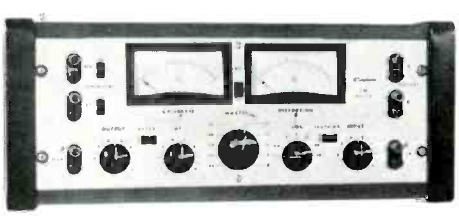


Gateley control panel

U.R.E.I. limiting amplifier 1176N



U.R.C. 16-track recorder



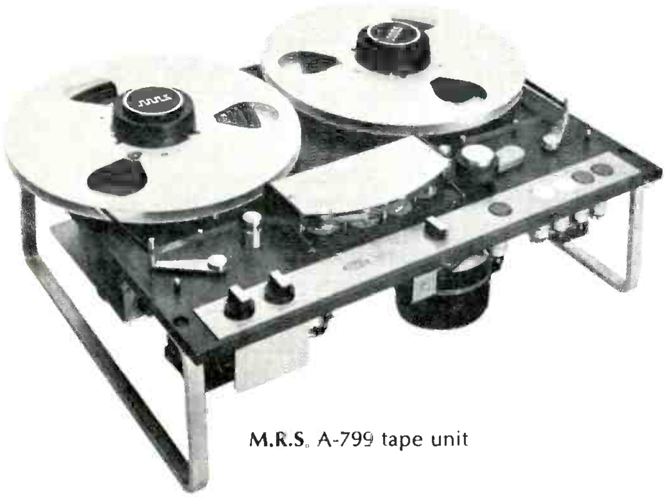
Crown IM distortion bridge

Sony ECM-22 condenser microphone

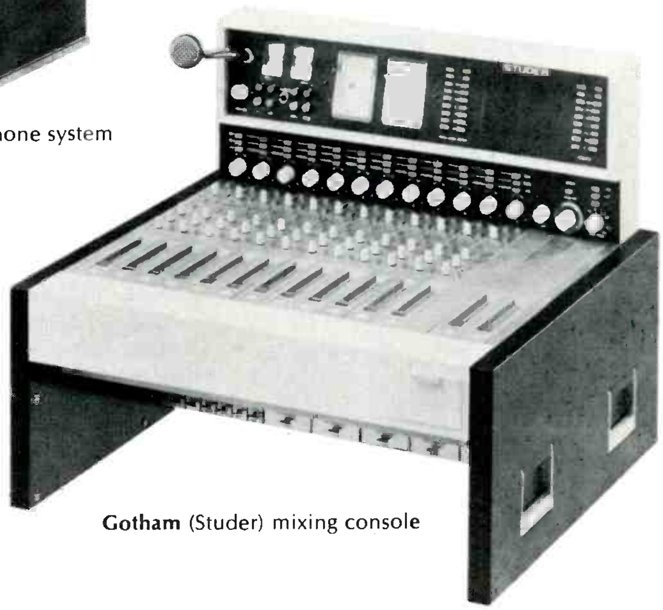
Crown 40-watt amplifier

Fairchild portable mixer unit

Vega VHF microphone system



M.R.S. A-799 tape unit



Gotham (Studer) mixing console

Altec portable 100-watt control console

General Radio comparator bridge

Langevin AM307 output-mixer unit

Infonics 4-cassette duplicator

BEHIND THE SCENES

BERT WHYTE

ALMOST COINCIDENT with the introduction of the 33⅓ long-playing record, magnetic tape became the standard medium for producing a master recording. Then as now, it was valued for its ease of handling and editing, wide frequency and dynamic range, and low distortion. On the other hand, there were also some problems like tape hiss, print-through, and crosstalk. That was in 1949, and although there were advances in magnetic head structure, tape oxides, and standardization of equalization, these noise problems still plagued the industry for 17 long years, until in 1966 a young physicist named Ray Dolby introduced a revolutionary tape-noise-reduction system.

The rest is history. Although a few die-hard skeptics still view the Dolby System with a jaundiced eye, most of the recording industry has enthusiastically endorsed it, and it is in use throughout the world . . . even behind the Iron Curtain! Most record companies here and abroad use the Dolby A301 noise reduction units in multiples. To name just two, London/Decca has over 50 units, Columbia something of the order of 80.

Dolby has become a common word in the lexicon of every knowledgeable audiophile. Most of them have some idea of how the system works and they own and enjoy disk recordings free of tape hiss, cut from Dolby System tape masters. While these audiophiles rightly regarded the Dolby System as the "tool" of the professional recording engineer, they were not unaware of the consumer-oriented potentialities of the system. The advantages of a noise-reduction system for home recording and for pre-recorded tapes were obvious. The question was whether a much simpler and far less expensive system could be derived from the highly sophisticated Dolby A301 unit. Dr. Dolby designed just such a system, and called his home-type noise-reduction system the "B" Type. A little later on I'll explain the differences between the two systems.

"B" Type in KLH Recorder

At any rate, the first result of Dr. Dolby's venture into the consumer field was a licensing agreement with KLH to incorporate the "B" Type system into a tape machine of their manufacture. The $650 KLH Model 40 tape deck was introduced in 1969, as was the Model 41, a simpler and less expensive ($229) tape deck produced in Japan. Both tape machines were well received by the hi-fi press at demonstrations which effectively proved the worth of "B" Type noise reduction. When sufficient recorders were in the hands of the public to get a meaningful reaction, it was of enthusiastic acceptance of the system. Thus was consumer-type tape noise reduction launched. However, it was obvious that not everyone was willing to buy a tape recorder in order to obtain the Dolby "B" system—especially those who already owned machines. What was needed was a "black box," an externalized version of what was in the KLH recorders, so the "B" Type noise reduction could be used with the kind of tape machines owned by most audiophiles.

On February 10th, 1970 the Advent Corp. of Cambridge, Mass., a licensee of Dolby Laboratories, introduced their version of the "black box" and demonstrated it to the hi-fi press and to some record company executives. They call their unit a "Tape Noise Reduction Center." Reaction to the device and to the idea was enthusiastic, especially when it was realized that this independent unit made tape noise reduction possible with any format—open reel, 8-track cartridge, or cassette—and paved the way for "Dolby-ized" pre-recorded tapes in these formats.

At this point I think it would be pertinent to review briefly the operation of the Dolby A301, the professional system, and how the "B" Type works.

Essentially the Dolby A301 is a highly sophisticated type of compression/expansion system, with some elegant solutions to the problems that have plagued this type of device for many years. For one thing, previous compression/expansion systems operated over the whole frequency band at all signal levels and under dynamic conditions one could hear the "swishing" and "breathing" sounds characteristic of that kind of circuitry. The A301 is set up to work on low-level signal components over four independent frequency bands. The bands are set for compression thresholds of 40 dB below peak operating level. The bands are divided as follows; Band One, 80-Hz low-pass; Band Two, 80-Hz–3-kHz band-pass; Band Three, 3-kHz high-pass; Band Four, 9-kHz high-pass. Band One provides noise reduction in the hum- and rumble-frequency range; Band Two in the mid-audio range (broadband noise, crosstalk, print-through); Bands Three and Four, in the hiss range. All the bands work together, in varying degrees of momentary noise reduction in their respective frequency ranges. The A301 is in two sections. One is the record processor, the other the playback processor. It is important to remember that high-level signals pass through the system unaltered, the masking effect of the ear making inaudible any background noise at those amplitudes. The noise that bothers us is that during low-level passages. In the record processor, all low-level signals are boosted 10 dB up to about 5 kHz. Above 5 kHz, the boost rises smoothly to 15 dB at 15 kHz and then levels out. This boost-

Your inevitable choice among automatic turntables. Sooner or later other automatic turntables will incorporate the exclusive features *now* available on the new PE-2040: Dial-a-Matic vertical tracking angle adjustment for all records . . . Independent, ultra-gentle, fingertip cueing control . . . Fail safe stylus protector . . . Automatic record scanner . . . Single lever control for all modes of operation . . . Continuous record repeat. These are just some of the exclusive features. Stop by at your PE dealer for the complete story and a demonstration of PErfection in PErformance. PE-2040—$145.00; PE-2038—$115.00.

Elpa Marketing Industries, Inc., New Hyde Park, N.Y. 11040

PE

PErfection in PErformance

ELPA

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ing (compression) occurs *before* the recording.

The processed signals are recorded on a typical professional recorder, which does not require any special modification for use with the Dolby System. In the playback processor of the A301, the recording is attenuated in a complementary way—in exact proportion to the boosted signals. At the same time, noise acquired in the audio channel (tape machine, etc.) is reduced. The amount of noise reduction is the same as the boost in the compressor . . . 10 dB up to 5 kHz, rising to 15 dB at 15 kHz. So the A301 reduces the tape hiss, hum, print-through, and crosstalk to levels which in general recording practice are inaudible. This is accomplished with no degradation of frequency response or added distortion. Nor can the action of the system be heard —there is no "breathing" or "swishing."

The Dolby "B" Type noise-reduction system works in the same fashion as the A301, except that instead of four independent frequency bands, the "B" Type has one band designed to reduce tape hiss. From the earliest days of home recording and the earliest pre-recorded tapes, tape hiss has been the bane of the tape enthusiast's life. It has been the greatest barrier to the growth of tape recording and has restricted the sales of pre-recorded tapes. The problems of print-through and crosstalk in home tapes has never been of the magnitude of the hiss, and in recent years their effect has been negligible. The "B" Type system gives 8 dB of noise reduction at 2 kHz, rising to 10 dB at 5 hKz. As in the A301, the "B" Type works only on low-level signals, boosts them before recording, attenuates them in complementary fashion on playback, and reduces tape hiss at the same time. The "B" Type system employs a record and a playback processor just like the A301, and there is no degradation of the audio signals in any parameter. In short, the system is a "kissin' cousin" of the professional A301, except it works on a single-band basis for the reduction of tape hiss.

Prototype Systems

When Dr. Dolby decided to expand the "B" Type system beyond its use in the KLH recorders he had his laboratory make up some prototype "B" system boxes for various interested parties. I was fortunate enough to be given two units (need two for four-channel recording) and I have had a chance to use them for some months now. I also have a prototype Advent "Tape Noise Reduction Center," and it is a handsome unit and it works flawlessly. The Dolby boxes are sleekly professional in appearance, and using them has taught me what to expect in the way of performance from the "B" Type system. The Advent unit was not found wanting in any respect, and as a unit designed for the consumer, it has some convenience facilities lacking on the Dolby boxes.

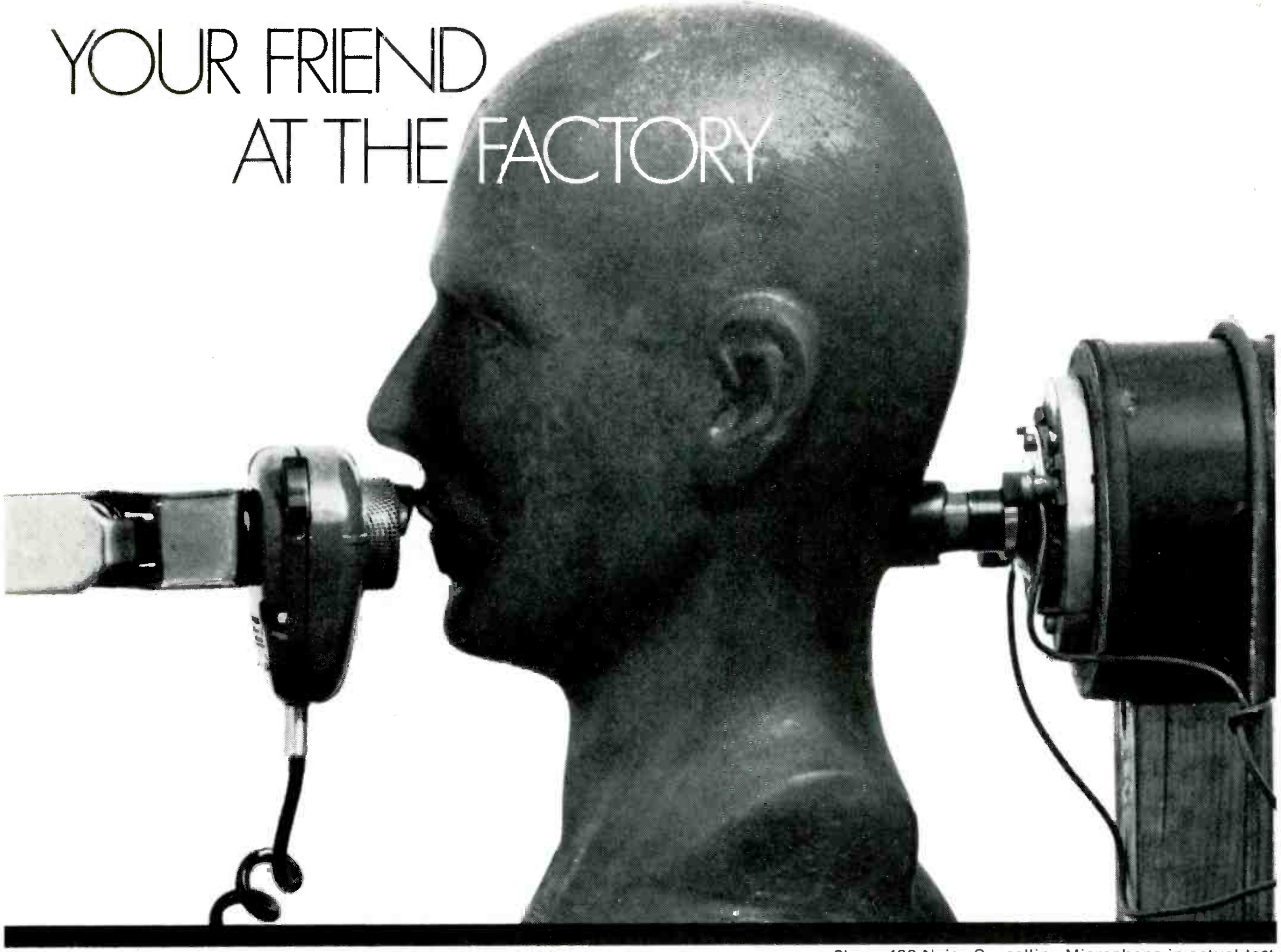
Quoting Advent on their "B" Type unit, "it is intended to be inserted in a component stereo system between an amplifier (or receiver) and a tape recorder. It becomes a unified tape recording control center with the following features: Separate input-level controls on both stereo channels for both microphone and line inputs. These maintain input-mixing capabilities for any recorder, and add these to any recorders presently lacking them; a master recording-level control that governs both stereo channels and allows recording level to be set without disturbing the balance of stereo channels or individual inputs; output level controls for each channel that permit matching the requirements of any pre-amp, amplifier, or receiver; a multiplex-filter switch that prevents recording interference from inadequate suppression of multiplex-carrier or pilot-tone frequencies by a tuner; complete calibration facilities for optimum use of the Dolby System with any recorder. These include calibration meters, an internal test-tone oscillator, and two "Dolby Level" tapes (open reel and cassette) that enable the unit to be set to a standard characteristic for all "Dolby-ized" tapes, including pre-recorded commercial releases. There are headphone output and source-tape monitor switches."

What Advent left out was a playback-tone level control on each channel, and a switch for each channel that in one position takes the Dolby noise reduction out of the circuit, and makes it operative in the other position at which point a tiny signal light goes on next to each switch. Setting up to use the Advent unit is fairly easy. Here is a typical situation: you feed the tape outputs of a pre-amp into the line inputs on the back panel of the Advent (all connections are standard RCA, except phone jacks for the microphones); from the Advent you plug into the line inputs on a tape recorder. From the outputs of the tape machine you plug into the "from tape" receptacles on the Advent. The "amp-out" on the Advent is connected to "tape-monitor in" on the pre-amp. Now you are all set to calibrate the system. For this you need special tapes (which will be supplied by Advent with each unit). The important thing is that the tapes must have a certain level of magnetic flux at a certain frequency. For reel-to-reel recorders if you want to operate at 7½ ips, a standard Ampex reproduce alignment tape will serve nicely. The reference flux level is 185 nanowebers per meter at 700 Hz. You play this tape back on your machine and by means of the playback-tone level controls of the Advent you set the needle of the calibration meters to the inscribed mark. Having done this, you do not again touch these controls, nor the output-gain controls on your tape recorder. For playback of "B" Type tapes this is all you need to do. If you want to record a Dolby tape with your Advent unit, you place a blank reel of tape on your recorder, switch on the internal oscillator on the Advent, place the input-gain controls on your recorder to some arbitrary position, say at the half way point of rotation, turn the record calibration level pots on the read of the Advent about half way. Now record 30 or 40 seconds of the signal. Switch to the monitor positions on the Advent and play back the signal you have just recorded. The calibration meters should deflect to the inscribed mark. If they do not, you must adjust either the tape recorder input-gain controls or the Advent's record-calibration pots for either more or less signal as the case may be. Record at the new setting and check the meters on playback. Once the meters are calibrated, the calibration pots on the Advent and the input gain controls on your recorder should not be moved. Control of recordings is by the master record control on the Advent, and you still set your overall recording levels by the VU meters on your recorder. Sounds a little complicated but it isn't once you have done it a few times. If you intend to use a cassette machine the calibration procedure is the same, except that you must use the correct cassette calibration tape with a reference flux level of 200 nanowebers per meter at 440 Hz.

How it Performs

What is it like using a "B" Type noise reduction system? It is a fascinating experience and at first a bit eerie. Mr. Marc Aubort of Dolby Laboratories and Elite Records was kind enough to furnish me with some "B" Type recordings, made from Dolby A301 masters. In a solo piano recording that was superbly clean, when you got to the quiet sections—the extreme pianissimos, and long rests in the music—the absence of hiss was almost unreal! As you get used to it you notice the much wider dynamic range, the extreme clarity of the recording. It is like exploring a whole new world. In the last movement of the Brahms 3rd symphony, it is star-

YOUR FRIEND AT THE FACTORY



Shure 488 Noise Cancelling Microphone in actual test.

Meet "Oscar," the hard-working plastic "android" of our environmental engineering department. Oscar helps our development engineers and quality control specialists check the acoustic interaction between a microphone and the person who operates it. He enables Shure to re-create precisely controlled and repeatable acoustical environments free of subjective guesswork. He's shaped like a human head, with special resilient plastic skin that has the same acoustic properties as flesh. He does his thing in a king-size telephone booth with 5-inch thick walls and doors because his full-spectrum mechanical voice can be as loud as a rock 'n roll group (or barely perceptible) and his chamber can be flooded with ambient sound that would drive a teenager up the walls. "Oscar" is typical of the care which Shure takes in designing a microphone that is *tailored to a given environment and situation*. (And, after the original design has been put into production, Oscar is the basis of repeated checking of production units against the original performance parameters.)

It's just *one* of dozens of ways that Shure strives to excel in environmental engineering. At Shure, we anticipate and solve field problems before they become problems.

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tling to hear the big orchestra in a full forte, and then a moment later a pianissimo and some rests—without a smidgin of hiss to mar your enjoyment. Needless to say, you can record FM "off-the-air" and from records with noise reduction, but you must remember that the signal-to-noise ratio will be only as good as the medium from which you are recording. The Dolby System cannot remove noise retroactively! However, you may still like the results for at least your tape machine will not be adding any noise of its own. If you are fortunate enough to make some live recordings, then you will get the full benefit of the noise reduction. In this respect, I think Advent might have placed the microphone input jacks on the front panel, rather than the rear. I have made some live recordings with the Advent with superbly quiet results. However, my most exciting live recording thus far, was one in which I used the Dolby prototype box. I was fortunate enough to record the Suffolk Symphonic Orchestra, an estimable group of 75 musicians. The concert was held in a school auditorium with pretty fair acoustics, although the stage treatment dampened some instruments too much. The program was ideal for testing the Dolby system—a Mozart "Figaro" overture, a cello concerto by an old Russian Romantic, Davidov, with a brilliant young soloist, Jeffrey Solow, who made his Carnegie Hall debut shortly after this concert. And, ambitious wonder, the complete 1947 version of Stravinsky's "Petrouchka"! Now the Dolby boxes have no mike inputs . . . just line only. I solved this by using the great Ampex AM-10 mixer, which among other things has a master gain control over both channels, two big VU meters, with a range switch to work at plus 4, 8, or 12 dBm, and best of all the input channels can be switched to either "A" or "B" channel or both. I used my ReVox two-track machine so I could edit, and was working at 7½ ips since the Dolby was calibrated for that speed. I used the fine Schoeps condenser mikes for left and right, and that superbly tight cardioid, the Electro-Voice RE-15 in the middle, split left and right so that on playback I would have a nice phantom center channel. Of course it also allowed better control on the cello in the concerto. The results were just terrific. There were many sections in the concerto that were quiet and Petrouchka was quite unbelievable in the great dynamic range I achieved, and the clarity of everything. There are many rests in Petrouchka and it was just great not to hear illusion-destroying hiss. When I had a chance a little later, I played the concert back through the Advent, and having calibrated it properly, the noise reduction worked like a charm. One of the things you can do with a Dolby tape is make a one-to-one copy to another tape machine *without going through a noise reduction unit*. I did this and then played the copy through the Advent unit to achieve noise reduction. Nice to know this if you want to send a Dolby copy to a friend who has the means to restore it via a "B" Type box.

A Deluxe Accessory

Of course, it is very obvious that this Advent box in a deluxe unit and it will sell for about $250. It is equally obvious that a simple playback-only box, suitable for use with pre-recorded open-reel or cassette tapes would be a desirable product. This is especially true with cassettes, whose terrible hiss has kept them from consideration as a medium for high-quality sound. I took the Petrouchka I had recorded and transferred it to cassette, using TDK "SD" and a Wollensak 4700 cassette deck, a fine unit with good motion and very low hum. The playback of the cassette was an eye-opener—not quite as quiet as the open-reel 7½-ips master, but incredible for a cassette.

The quality was amazing too, in terms of dynamics, frequency response, and transient response. Many of my friends who have heard it can hardly believe this is coming from a cassette. Getting back to the playback-only "B" Type box, Advent has this in mind as a product too, and before long. Dr. Dolby has come up with some new developments in this respect and it is reportedly possible that such a unit can be made to sell to the consumer for between $50 and $100. If this is so, this will lend great impetus to the possibilities for Dolby-ized pre-recorded tapes in every format. In fact, I am very pleased to report to you that the ball is already rolling. Jac Holzman of Elektra Records, who was first on the market with a Dolby disk, is going to issue a Dolby-ized "B" Type cassette of Sibelius' "Legends of Lemmenkainen." Seymour Solomon, president of Vanguard Records and another Dolby pioneer, has told me that within two months he will issue a limited number of Dolby-ized "B" Type open-reel and cassette recordings. I know of one other record company which is tottering on the brink, and I'm pretty sure will have agreed to put out Dolby tapes by the time you read this. It is the old story of the chicken and the egg that we went through in the early days of stereo. As soon as a few of the Advents reach the market, and the public hears how great an improvement noise reduction makes in their music, things ought to open up, and the major record companies will hop on the bandwagon. It is an idea whose time has definitely come. While it is true that one of the advantages of the Dolby system is that you can get top-quality results by recording at slower speeds and thus save on tape, I think that's fine; but the main thrust is that at last we will be able to buy pre-recorded tapes unsullied by that old demon hiss! Æ

Dear Editor.....

DEAR SIR:

I would like to thank Paul Klipsch for his article, "Another Look at Damping Factors," in your March issue. He explains that all the resistance in the circuit, even the d.c. resistance of the connecting wires, must be added to the internal impedance of the amplifier to get a meaningful figure for the true damping of the system.

Unfortunately, many people have not understood this limitation on damping. Some have felt that amplifier internal impedance *per se* was a figure of merit, as if an internal impedance of .01 ohms were better than one of 0.1 ohms. As Mr. Klipsch points out, the amplifier is so small a portion of the circuit resistance that it can have practically no effect on damping—assuming normal design which has a generally low internal impedance.

Another source of confusion to many users is the need for *matching* the speaker impedance to the amplifier impedance. Mr. Klipsch correctly indicates that nominal mismatches (such as 16-ohm speaker and 4-ohm amplifier) make only a minute difference in response and distortion. The only effect of mismatch is that the amplifier cannot deliver its maximum power into a mismatched load. At any power less than maximum, a mismatch is of no consequence. Further, no loudspeaker maintains exactly the same impedance at all frequencies, so that even with an attempt at matching, this is a compromise which results in mismatch at some parts of the sound spectrum.

It is safe to assume that with any modern amplifier and any loudspeaker in the 4- to 16-ohm range, the only matching problem to be considered is whether the amplifier has adequate power for the efficiency of the speaker used and for the size of the area to be covered.

DAVID HAFLER
President, Dynaco Inc.

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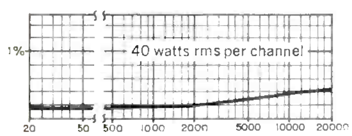
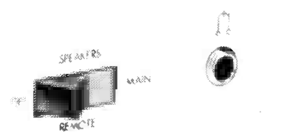
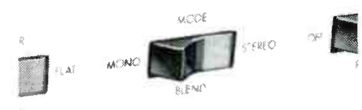
SCA-80 amplifier



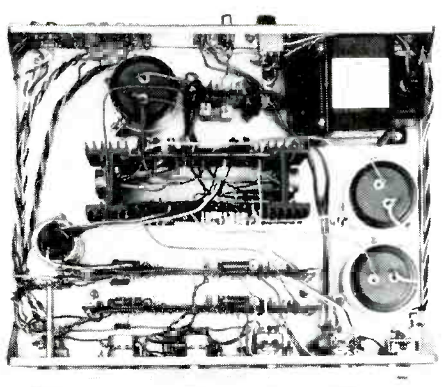
The SCA-80 delivers 40 watts per channel rms continuous power from 20-20,000 Hz at 8 ohms. Plenty of power for driving 4 ohm speakers too.



Front panel low-impedance headphone jack is always live. Rocker switch permits you to choose between main and remote speakers too, or turn speakers off.



Center channel speaker can be driven without an auxiliary amplifier with mode switch in BLEND, which also reduces unrealistic stereo separation when using headphones.



Open, uncluttered layout facilitates kit construction. Four etched circuit boards are factory assembled and tested.

The Dynaco FM-3 tuner ($99.95) is completely compatible with the SCA-80. The SCA-80/FM-3 system delivers up to three times more continuous power across the audio band than other one-piece receivers in the same price range.

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Tape Guide

HERMAN BURSTEIN

Recorder Connections

*Q. I own a * * * * tape recorder and use it with a stereo receiver. When I connect the tape-output jacks of the receiver to the line-input jacks of the tape recorder, the recorder works correctly, and only monitors the receiver signal when in the record mode. When I connect the line-output jacks of the tape recorder to the tape-monitor jacks of the receiver, it also works correctly. But the other day I accidentally connected the tape-output jacks of the receiver to the line-output jacks of the tape recorder, and was quite startled by the results. My tape recorder monitored the receiver signal only in the "play" mode, and the incoming signal was not affected by the recorder's volume or tone controls, and the VU meters of the tape recorder did not register. When in the record mode, the recorder worked normally and did not register an incoming signal unless one was fed into the line input jacks. Is this normal, or did I inadvertently damage my tape recorder?*—Bruce Schwartz, Philadelphia, Pa.

A. First of all, it is highly unlikely that you damaged your tape recorder. Your description of what happened, so far as I can follow it, seems to be what one would normally expect for a misconnection such as you made. For a more precise reaction, I would need schematics of your tape machine and receiver, together with a more detailed and clearer description of exactly what happened.

Hysteresis Motors—And Hiss

Q. Is the hysteresis-synchronous motor an especially desirable feature? Will a frequency response to 20 kHz introduce an objectionable amount of hiss?—A. L. Bowling Jr., Lynchburg, Virginia.

A. A hysteresis motor to drive the capstan is desirable in the interest of accurate tape speed and uniform speed from one end of the reel to the other.

I doubt that frequency response to about 20 kHz, provided this is essentially flat response, will add significant hiss when compared, say, with a response to about 15 kHz. Hiss is most apparent to the ear in the region of about 3 kHz to 5 kHz.

Overloading

Q. How can I check if the recording amplifier of my tape machine is overloading before the tape is saturated? I have access to an oscillosope, VTVM, harmonic distortion analyzer, signal generators, and VOM.—Seitoku Nashiro, Arlington, Virginia.

A. Record and play back a mid-frequency signal of about 400 Hz. Monitor the tape playback on the 'scope. Keep increasing the level of the recorded signal until the 'scope shows a distorted waveform. Now check the waveform at the output of the recording amplifier (at the input to the record head); if it looks undistorted, you are not overloading the amplifier.

Endless Loops

Q. I wish to use a tape recorder as an aid in my musical instrument lessons. My instructor would record a passage, ranging from 30 seconds to several minutes. I would play along during playback of the tape. The recorded passage should repeat endlessly, without requiring my instructor to record the same passage more than once. How can I achieve this?—D. Menkes, Westmont, New Jersey.

A. By borrowing a second tape recorder (say from a friend), you can copy the original recording over and over through the length of a reel. If you purchase a tape recorder with automatic reverse in both directions, you can play such a tape endlessly.

VU Meters

Q. I made the mistake of advancing the output level too far on each channel of my tape recorder, and pegged the VU meters. Could the meters be damaged in this manner? —John D. Moss, Aartselle, Alabama.

A. If the meters are true VU meters, they can take a very substantial overload without damage. They can continuously withstand a voltage 5 times as great as that which is required to drive them to a reading of 0 VU. And they can withstand for 1/2 second a ten-fold voltage overload. If they are not true VU meters, it is anyone's guess what might have happened to them as the result of pegging. The chances are that the manufacturer of a high-quality tape machine would use meters of comparable quality that can withstand pegging within the capabilities of the machine's amplifiers. One way that you *might* be able to tell if the meters have been affected is to feed in a steady signal while recording, and see whether they give the same reading in both vertical and horizontal position. If they do give the same reading in both positions, quite likely they have not been harmed. Also see whether the same signal produces the same reading on the two meters; it should.

Bias Adjustment

*Q. I own a * * * * tape deck and wish to adjust bias for optimum performance with the tape I am using. I plan to adjust bias to peak and output level while recording a 1600-Hz sine wave.*—Ronald Brey, Mankato, Minnesota.

A. The procedure you describe is approximately the one generally used and apt to give optimum or close to optimum results. However, you might try increasing the bias until output drops about ½ dB below peak output. If this does not cause undue treble loss (say no more than 2 or 3 dB loss at 15,000 Hz at 7.5 ips), then it is a desirable adjustment of bias; it results in less distortion and in less susceptibility of treble response to slight changes in bias current (owing to warmup, line-voltage variations, etc.)

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

When you're #1 in tape recorders, you don't make the #2 tape.

If you've got a few hundred bucks tied up in a first-quality tape recorder, you're not going to want to gum up the works with second-rate tape. Especially when just a few extra pennies buy the finest Sony professional-quality recording tape.

Not only will Sony tape make any recorder sound its best, but it'll keep it sounding that way. Because our tape won't shed or cover tape heads with a performance-deteriorating oxide coating. Head-wear, too, is minimized, thanks to Sony's exclusive Lubri-Cushion process, which impregnates the tape with long-lasting lubricants.

Sony tape comes in all configurations: Open reel. Eight-track. Cassettes.

Open-reel tape is available in 3¼", 5", and 7" sizes. The new Sony SLH-180 low-noise, high-output tape is available on 7" reels only. And "Easy-Threader" tabs make every Sony open reel self-threading.

Our professional-quality tape is also available in eight-track stereo cartridges plus new Easy-Matic cassettes for both functional and stereo units, with 60, 90, or 120 minutes' recording time.

To hear the best, play the best. Sony Professional-Quality Recording Tape. From the people who offer the number-one line of tape recorders—Sony/Superscope.

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Editor's Review

Readers will notice a significant increase in the number of technical papers to be presented at the West Coast AES Show (see pages 42-45). Actually, there are 89 compared with 65 last year and the total number of exhibitors is also higher—65 against last year's 45. Another indication of the healthy state of the industry is the fact that the AES journal is published six times a year instead of four, and a quarterly supplement devoted to medical electronics will appear later this year (more work for Jacqueline Harvey!).

Many quadraphonic demonstrations have been given up and down the country during the past month—including the long-awaited première of the Scheiber disc. This event was held under the auspices of the AES and speakers included John Eargle, Len Feldman, Jerry Minter, as well as Peter Scheiber himself. Several hundred people were present, in fact the large room was filled to capacity. What was the sound like, was there really four channels on the records? Well, the room was extremely reverberant and the sound from the four loudspeakers echoed around—to quote Ed Canby "like an Electronic Circus." The loudspeakers were very boomy and what with the aforesaid reverberation piled on reverberation it was impossible to make a valid judgment. No doubt about it, quadraphonic sound is at its best in small rooms: it is intimate, immediate, and often exciting. In a large hall —at least with present recording techniques—much of the recorded ambience disappears, overshadowed by the room acoustics. A few days later, another demonstration was given in a small room and here the sound was quite impressive.

Program material was far from ideal—Simon and Garfunkel in 4-channel did not really offer a dramatic improvement, but I must admit many of the listeners *liked* the experience of being surrounded by S, G, and Mrs. Robinson. . . . But was there really four channels? The answer is a qualified 'yes'. The Scheiber system depends on phase and precedence effects to create four separate channels but I do not know how the final result compares with the original sound. I am glad to report that Peter Scheiber has promised to write an article describing his system as soon as the patent situation is finally resolved.

Len Feldman gave a quadraphonic demonstration in Philadelphia recently using Vanguard tapes played on a Crown recorder and a modified cassette machine. Although the room was fairly large, the results were most convincing and reaction was very favorable. The Berlioz Requiem in particular was extremely impressive—probably because of its highly dramatic nature and the fact that it was composed for four brass bands, a full orchestra, (not to mention ten pairs of cymbals) plus several ensembles. Berlioz was no skinflint! Len will be giving another demonstration on June 3, and this one will be at the Dragon Seed restaurant, 37th St., Jackson Heights, New York. Time: 8 p.m. It is sponsored by the New York Audio Society and Len tells me that he may use closed-circuit FM transmission with the Halstead-Feldman system.

* * *

Many enthusiasts are familiar with those special demonstration records that promise so much but often have a harsh, clinical sound. Here is one that can be recommended. Entitled "Lincoln Mayorga and Distinguished Colleagues" it is made by direct transfer to disc method (no tapes are used) by the Mastering Lab, 6033 Hollywood Blvd., Los Angeles, Cal., 90028. The performers are a group of West Coast musicians and the sound is clean and spacious with a good dynamic range and hardly a trace of 'chromium plating'.

* * *

The letter from Dave Hafler (page 14) mentions the effect of high-resistance speaker wires on an amplifier's damping factor. A chart giving wire guages and resistance was printed in our February issue. Unfortunately, the author, Osamu Goda did not emphasize that the d.c. resistance of the voice coil itself has to be considered in calculating the effective damping.

* * *

I must say I find the *FM Guide* a great help in allowing me to pick my programs from the enormous amount of music on the air these days. It is well written and the station listings are easy to follow. In the April issue, Allen Shaw writes about the generation gap in music and I was disconcerted to read ". . . just because an 18-year-old looks the part, don't assume he's an FM listener and draft resistor." Times have indeed changed!

G. W. T.

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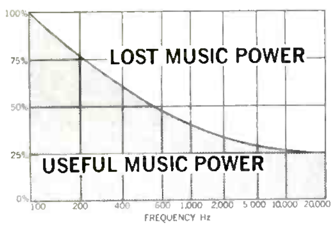
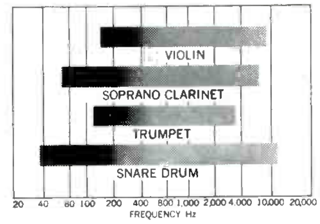
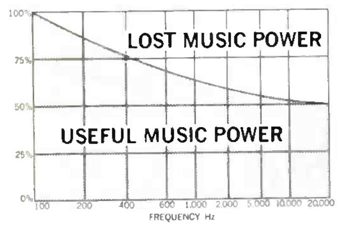


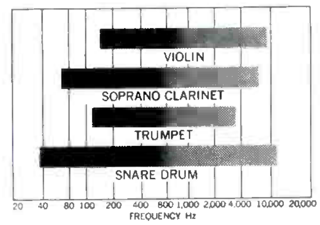
CARTRIDGE "C"
at 25% Music Power



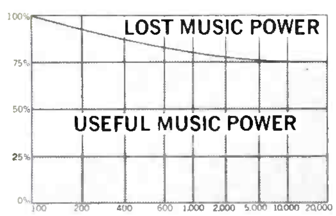
. . . a serious loss of definition occurs: because cartridge "C" has completely lost 75% of the Music Power at the higher frequencies.



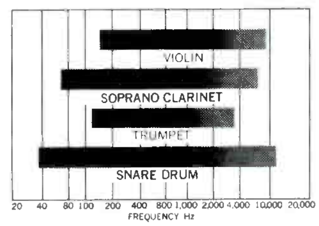
CARTRIDGE "B"
at 50% Music Power



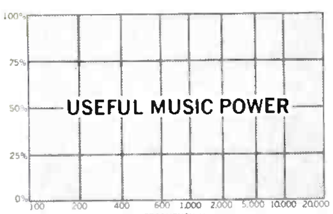
. . . in this case you lose definition of tone and instruments: because cartridge "B" loses as much as 50% at higher frequencies.



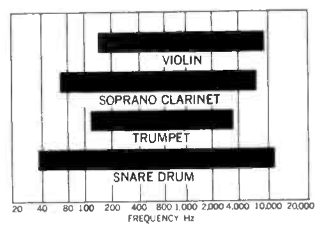
CARTRIDGE "A"
at 75% Music Power



. . . the instruments seem a little faded in the upper frequencies: because cartridge "A" attenuates higher frequencies as much as 25%.



XV-15
at 100% Music Power



. . . the instruments, all of them, are distinct and clear throughout the entire fundamental frequency range.

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15 Channels on One Pair of Wires

C. G. McPROUD

The Boeing 747 is a BIG plane, and TWA has employed a multiplexing system to provide passenger entertainment facilities with a minimum of wire and great savings of weight.

JUST IMAGINE how much wire would be required to "pipe" fifteen channels of audio to each of the 342 seats on TWA's new 747's, letting each listener choose which of the programs he wanted to hear. In the conventional way, this would involve some 800 pounds of wire, in addition to hundreds of connections to the switches. TWA—the most experienced airline in passenger entertainment— does it in a different way. They do it by multiplexing. And to effect a further saving in wiring, they also multiplexed the passenger service facilities—individual lighting and hostess calling—and the overall saving in weight is of the order of 500 pounds

Publicity on the 747 has made everyone aware of just how big the ship is—an overall length of 231 feet 10 inches, a wing span of 195 feet 8 inches, and a height of 63 feet 4 inches at the tail. It has a maximum takeoff weight of 710,000 pounds, of which 112,500 pounds is payload. There are 12 rest rooms, six galleys, seven portable beverage dispensers, and five complete movie theatres in each 747—three of which show general pictures, while the other two feature "mature" films. You choose your seat by selecting the picture you want to see.

In addition to the movie sound tracks, ten additional sound programs are provided to each of the seats, several of which can be stereo. The fifteenth channel is provided for override of announcements from the captain or from the hostesses in the three sections of the tourist compartment and the two in the first-class compartment. Another system provides a series of multi-lingual "canned" announcements at the hostess' selection. The 747 has room, and it also has some sophisticated electronics to accommodate the needs of the 58 first-class and the 284 tourist-class passengers. One has to see the 747 to believe it.

Multiplexing

To make it possible to transmit fifteen channels of information over a single pair of wires, multiplexing is resorted to. In the past, multiplexing was accomplished primarily by frequency-division—that is, each program modulated a specific carrier frequency, and all were combined in a wideband output. The individual programs were sorted out much in the same manner as one selects any one of many AM broadcast stations on the air at once. Because of the possibility of r.f. interference with the navigation and communication requirements of air travel, another means was used in the 747, and this method is known as Time-Division Multiplexing. This is accomplished by switching sequentially from one channel to the next at a rapid rate—in this case, 26,000 times per second.

There are several different forms of Time-Division Multiplexing—pulse-amplitude modulation (PAM), which transmits one pulse per sample with the amplitude of each pulse proportional to the amplitude of the sample. Pulse-width modulation (PWM) transmits one pulse per sample and varies the duration of each transmitted pulse in proportion to the amplitude of the sampled input. Pulse-position modulation (PPM) transmits two pulses for each sample—a reference pulse and a data pulse, with the time elapsed between the reference pulse and the data pulse being proportional to the amplitude of the sampled input. Pulse-coded modulation (PCM) transmits a series of pulses for each sample. The pulses represent a binary number, and the magnitude of the binary number represents the amplitude.

PCM is the only one of the four methods which is truly digital, and thus independent of amplitude. Since this is the case, the system can employ a threshold below which noise cannot affect the output, and it is only necessary that the pulses be just above the threshold. Therefore it is possible to re-establish the pulses without increasing the noise in the system simply by adding amplification. This provides an immunity to all sorts of problems in addition to noise—mismatches, imperfect connection resistances, stray reactances. The system results in minimum radio-frequency interference, ease of maintenance, simpler cabling and installation, and higher quality of transmission.

Creating the PCM signal involves a device known as the multiplexer which commutates the inputs sequentially, samples and holds them at the level of the sample at the time of the sampling, converts the analog signals into digital pulses, and then combines the result with the sync-pulse generator to feed the transmission line.

In the TWA entertainment system —which was developed by ISC-Telephonics Division of Instrument Systems Corporation (which is, by the way, the parent company of Benjamin Electronic Sound Corporation as well as some forty other subsidiaries)— employs a zone system of distributing the program material throughout the plane. This is necessary because of the different series of programs which must be fed to the various compartments. The output of the main multiplexer is fed to two zone multiplexers in the first-class cabin, and to three

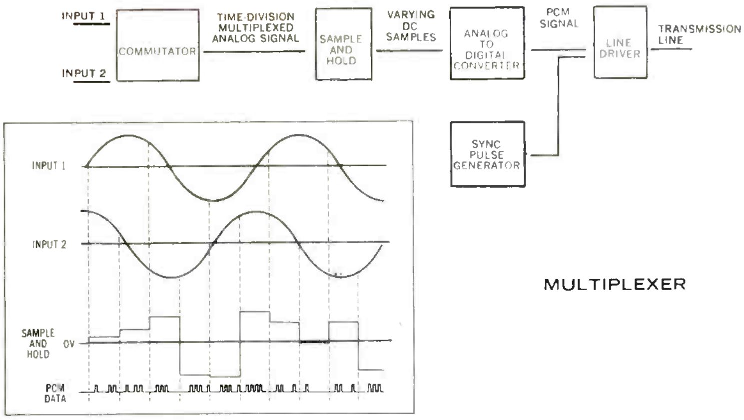


Fig. 1—Simplified block diagram of the main multiplexer and waveforms showing how it functions. Fig. 2 (right) The main multiplexer alongside a pack of cigarettes to show size.

additional zone multiplexers in the economy cabin. While the main music programming is fed throughout the plane, separate sound-track programs must be fed to the five "theaters," and it is at the zone multiplexers that the outputs from the five projectors are introduced to the inputs of the separate zone multiplexers. The various outputs are then fed to the separate cabins. At each seat group is a separate demultiplexer controlled by the switches in the passenger arm rests, and the two or three outputs from this demultiplexer are fed to the passenger headphone amplifiers. The demultiplexer receives the PCM signal from the zone sub-multiplexer, converts it to an analog which is a PAM (pulse-amplitude-modulated) signal, then commutates it to select the desired program and filters out the products of the multiplexing process before feeding it to the passenger headphone amplifier. Bear in mind that some of the fifteen channels are used in pairs for stereo programs while the remainder—including the PA system program and the movie sound track for the section being fed—are mono. Thus it would be possible to have two stereo programs, for example, together with six mono channels fed into the main multiplexer, with the PA and movie channels fed into the zone sub-multiplexers along the plane. Since each passenger is provided with stereo phones (the transducers are in the arm rests, and their acoustic outputs are fed to the passengers' ears through paired plastic tubing), two separate amplifiers are required for each of the 342 seats. These amplifiers—150-mW solid-state units—are located at each seat position.

The entire electronic system for passenger entertainment is solid-state, naturally, and we are told that there are about a million transistors per plane, give or take a few thousand. These are not discrete transistors, of course. Some of the large-scale integrated circuits have as many as 800 transistors on a single clip.

Multiplexer Functioning

To go into more detail of the operation of the multiplexer, refer to Fig. 1 which shows the waveforms present when the system is sampling only two audio signals—Input 1 and Input 2. The vertical dashed lines represent the actual times of sampling the individual inputs. At the first sample, input 1 is positive, and of low amplitude. This is shown in the waveform at the "sample and hold" device as a straight line of the amplitude of the input at the time of sampling. The next sample is taken from input 2, as directed by the commutator, and this results in another "step" in the sample-and-hold waveform. The commutator again directs the sample to be taken from input 1, and another step is shown, also a positive value. The next sample is again from input 2, and this time the audio wave is negative, and this shows up as a negative step in the sample-and-hold wave.

The analog-to-digital converter now produces a series of pulses which indicate a digital number corresponding to the amplitude of the s-&-h waveform. These pulses are then combined with the sync-pulse-generator output and fed through the line driver to the transmission line.

The main multiplexer is shown in more detailed block-schematic form in Fig 3. The 12 audio inputs are fed into the "self-test" relays, of which more later, and thence into the audio filter/amplifiers, or processors, which shape the audio signals to conform to the system requirements. The outputs from the processors—still 12 in number — are then channeled to the commutator which samples them sequentially and delivers the sample

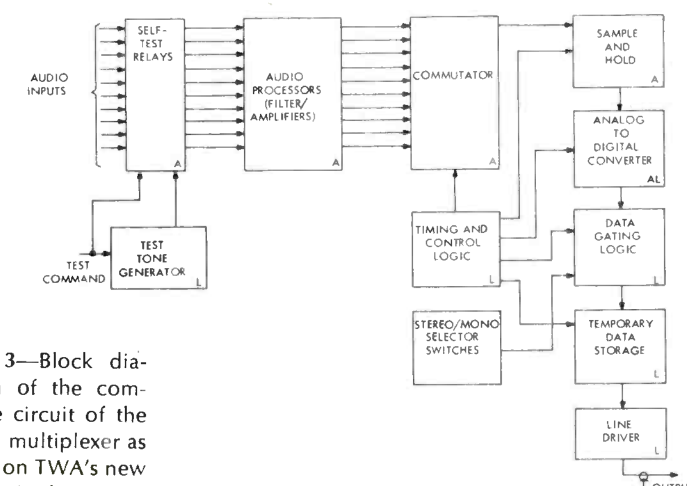


Fig. 3—Block diagram of the complete circuit of the main multiplexer as used on TWA's new 747 planes.

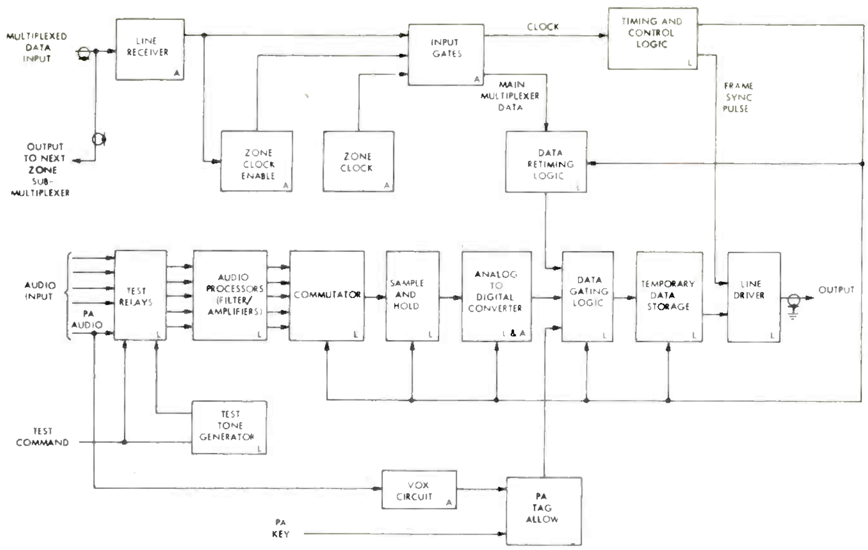


Fig 4—Block diagram of a zone multiplexer. Five of these are used on each plane, and they combine the main signal with those which are unique to the particular zone—Stewardess PA, and the movie sound track.

amplitudes to the sample-and-hold unit, so it now has a waveform in a series of steps which represent the amplitudes of the 12 signals at the time of sampling, and these series are repeated 26,000 times per second, as directed by the timing and control logic.

The output from the s-&-h unit feeds the analog-to-digital converter, which is also under the control of the timing unit, and it generates a series of pulses for each of the steps, depending on the amplitude of each step. This digital signal now enters the data gating logic where the stereo "tags" are added onto the odd numbered channel of a stereo pair so as to indicate that the next higher even-numbered channel is paired with it for stereo. Any odd-numbered channel may be paired with the next even-numbered channel to produce a stereo pair. The signals finally feed the line driver, and thence the transmission line.

The transmission line is, of course, a coaxial cable, as one can determine from a consideration of the frequencies involved. For instance, there are 26,000 samples per second. These are converted in the analog/digital device to as many as four pulses per sample, and each pulse has a positive and a negative transition. Therefore, we have a minimum of 2 x 4 x 26,000, or some 208,000 "changes" in polarity. If we are to maintain a reasonably sharp waveform—that is, with well-defined pulses—we usually consider that we need about ten times the frequency of the pulse, so we are somewhere in the vicinity of 1 to 2 MHz, at least.

Thus we enter the zone submultiplexer a number of other audio signals which are unique to the zones in the plane. These include the movie sound tracks and the zone PA system from the hostess. These new audio signals have to be processed in just the same manner as in the main multiplexer to result in a digital signal before they are added to the output of the main multiplexer to feed the passenger electronic demultiplexers. This involves some reshaping of the original line signal, and the interweaving of the two digital signals. The output of the zone unit is then fed to the seats in the particular zone, and the input from the main multiplexer is multiplied onto the next zone, where the same process is repeated. There are five separate zone submultiplexers on each TWA 747, and each is of the configuration shown in Fig. 4.

The zone outputs feed all of the seat electronic units — one strip of three-seat modules, and three strips of two-seat devices. These demultiplexers, shown in Fig. 5. accept the signals from the zone multiplexers, separate out the digital "0" and "1" signals, and feed them to the seat logic modules where the stereo and PA over-ride "tags" are introduced. The resulting outputs are fed to another converter—this time a digital-to-analog unit—and thence to the Mosfet module, which might be termed a "decommutator," in that it picks out the desired portion of the amplitude-modulated signal at the command of the seat selectors—two or three, depending on the string of seats in which the demultiplexer is located. (There are three seats in each group in the string along the left side of the plane, two strings of two-seat groups in the center, and one string of two-seat groups along the right side, of the plane. There are two aisles running the full length of the plane, making for easy movement of passengers.)

The seat electronics demultiplexers feed the separate pairs of headphone amplifiers, and thence drive the transducers. These are similar to hearing-aid earpieces, and are built into the seat control unit which accommodates the 12-position program selector switch, a dual volume control, the overhead reading-light control, and the hostess call button. The acoustic outputs from the transducers are fed to the passengers' ears through the plastic tubing mentioned before. The typical seat control unit is shown in Fig. 6, which is the type used in the first-class section by TWA. A wide variety of control units is available, so no two airlines will have exactly the same type—a matter of decor, undoubtedly—but they are all similar, and all perform the same functions.

In addition to the passenger entertainment system just described, another complete multiplexing system is employed on the 747 to provide for passenger services, without the need for large numbers of wires. These

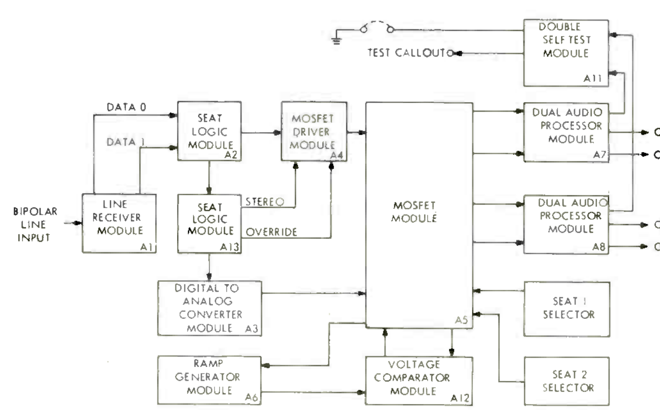


Fig. 5—Passenger seat demultiplexer, where the digital line signal is converted to analog form and the individual program is selected by the passenger.

services are less demanding in frequency response, but work on a similar principle at a considerably slower rate.

If a passenger wants his reading light on, he pushes a switch button. This action places a "1" on his seat position time slot, and as the many seat groups are scanned, the "1" causes an SCR in the overhead unit to fire and light his reading lamp. Similarly he can signal the stewardess, using another time slot. All of this makes it possible for the stewardess to turn on all reading lights or turn them off simultaneously without the necessity of running the numerous wires that would be necessary if each circuit had to be of the same configuration as the "two-way" switching in our homes.

Self-Test

The "self-test" feature mentioned previously makes it possible for a maintenance man to test all of the systems in the plane in about fifteen minutes. He simply energizes the self-test circuits, and proper functioning is indicated by some chosen method, such as a flashing of reading lights. The method is to disconnect all the usual inputs to the main multiplexer and feed each channel with a tone. This test tone is multiplexed and pulse coded and then distributed to all the seat electronics units, where it is demultiplexed and reconstructed as an audio signal, and has thus passed through the entire passenger entertainment system. A similar system tests the passenger service system, making it unnecessary for a maintenance man to go to each seat and try out everything—a job that would take several hours for the 342 seats.

Space Requirements

In spite of all each unit performs, none of them is large. The main multiplexer is about 3 x 4 x 19, and is shown with a pack of cigarettes alongside it in Fig. 2. The passenger seat electronics unit is about 5 x 6 x 2, and accommodates the entertainment and service electronics in this small package. The zone submultiplexer is about 4 x 8 x 12, and the entire multiplex system (exclusive of tape player, movie projectors, and the PA system) weighs about 250 pounds, resulting in a net saving of the previously mentioned 500 pounds. The system requires about 5 kW of power, but that is a fairly simple problem since each of TWA's 747s has four 60-kW generators feeding 110/220-V, grounded-neutral circuits.

Fig. 6—Passenger's control unit, located in the seat armrest. Program selection, volume, reading light, and hostess call button are provided here, as well as control for reclining seat back and the new "lumbar" inflatable cushion for support to the passenger's lower back area.

Program Sources

The numerous programs are recorded on tapes which are played from open-space "cassettes—that is, there are no reels, but the tape feeds into the cassette, weaves back and forth in whatever space it can find, and finally comes out the other side to feed past the head, leaving room for more tape to enter the cassette. The housing for the cassette player is shown in Fig. 8. and is located in the compartment under the floor of the passenger compartment. This space is simply loaded with electronic gear—radio equipment, radar equipment, navigation computers, passenger address audio, and so on.

The Movie Projection System

Each of the five movie projectors can be loaded with film long enough to play continuously for four hours, using a reel about three feet in diameter working on the same principle as the common 8-track cartridge. That is, the film comes out at the center of the reel and is fed back onto the reel on the outside, thus being "rewound" as soon as one showing is complete. Figure 8 shows one of the projectors lowered from the overhead for servicing or changing the film. Four hours of 16-mm film means about 9600 feet of film, which accounts for the large reels. The hand of one of the maintenance men is shown at the lower right of the projector in the figure.

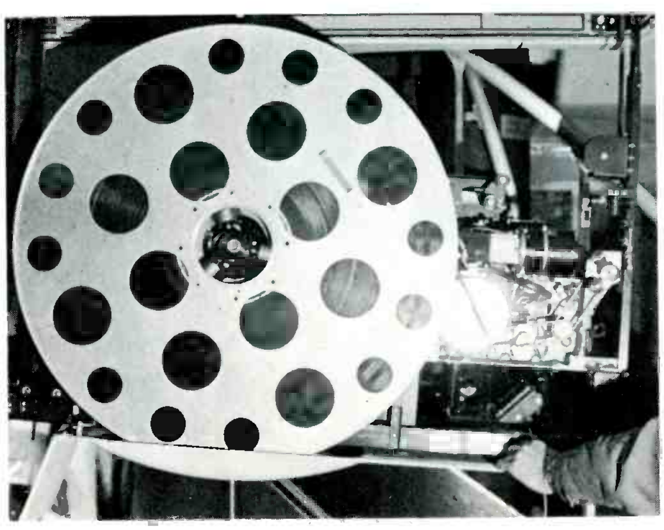
Performance

After all this, your question is certain to be, "How does it sound?" Surprisingly good, believe it or not. The tight coupling between the soft rubber pads and the passengers' ears makes for excellent bass response, and the high end extends to above 8 kHz. System frequency response is flat from 70 to 10,000 Hz, and the tape players maintain a ±3-dB tolerance. The movie screens are quite large and accommodate wide-screen pictures. The flutter is audible, but not worse than theatre movies, of 1935, for example. But you don't have to listen on the TWA 747s if you don't like the music and don't want to hear the movie. You can just sit there and eat if you wish.

Historical

TWA has a long history of passenger entertainment, starting with their first demonstration flight with sound on December 7, 1960. This was done with very little fanfare, but proved so popular that it was introduced regularly with a press flight in July, 1961. The hollow-tube "headset" was introduced in 1964 because there was a large loss of the usual earphone units. People seemed to think they were legitimate souvenirs. (They still carry off many of the hollow-tube units. One wonders

Fig. 7—Movie projector swung down from the overhead for servicing. 9600-foot reel provides four hours of continuous picture.



what they do with them when they get them home and try to plug into their hi-fi sets.) Stereo has been offered as regular fare since 1965, and now in the 747s you have your choice of 12 programs and two movies.

The writer is deeply indebted to TWA and ISC personnel for much of the information presented, and in particular to Charles C. Zambello, Manager—TWA In-Flight Entertainment, and William Gasper, Supervisor—Aircraft Electrical Development, and for much of the technical information about the multiplex systems to J. Schachter, Vice President, Commercial Systems, ISC/Telephonics, whose seventeen years of experience in microwave systems and related equipment qualitfy him as an excellent teacher.Æ

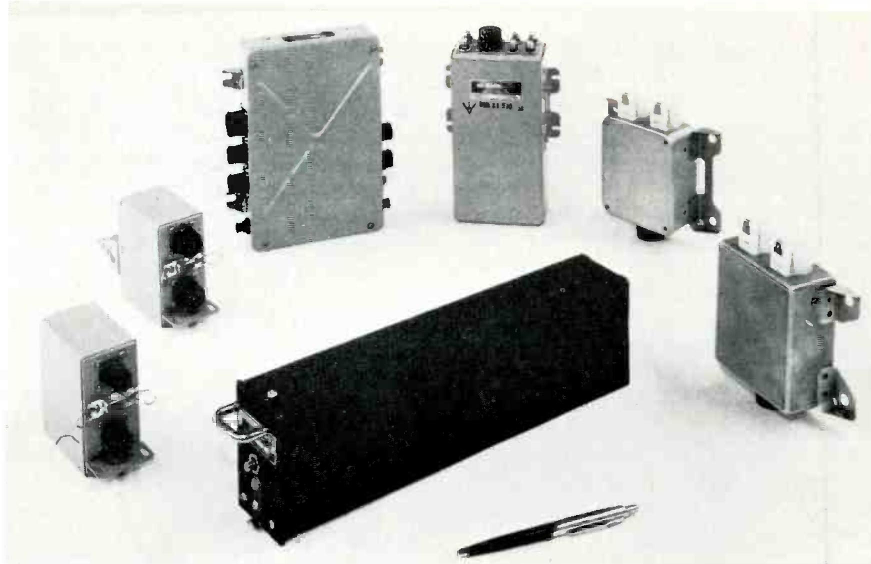
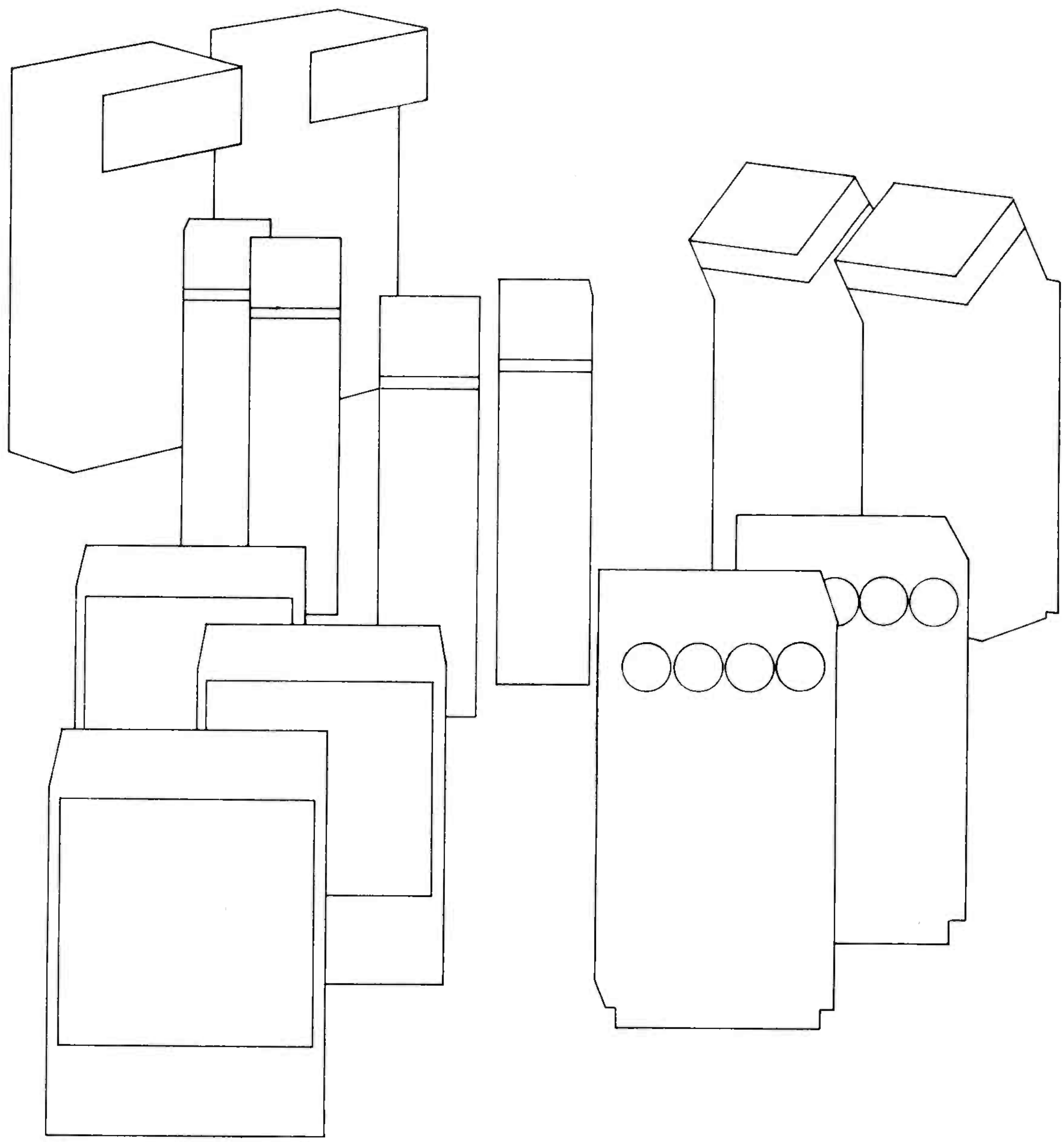


Fig. 9—Grouped around the main multiplexer are two junction boxes, zone multiplexers, and seat demultiplexers. Each is packed with solid-state printed-circuit boards, as might be expected considering the complexity of the circuits involved.

Fig. 8—Amid a whole array of electronic equipment under the floor are the main multiplexer (left center) and the tape reproducer (right center). Below it is the main PA amplifier which feeds the 61 Jenson speakers.

Fig. 10—Some idea of the spaciousness of the 747 can be gleaned from the above. Nine seats across, the economy cabin is 20 feet wide and has two aisles.

Fig. 11 (left)—William Gasper indicates hostess control panel for lights and call signals. Above are the multilingual control for programmed announcements, and the "boarding-music" control panel.



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ALFRED MAYER

A New Electronic Synthesizer

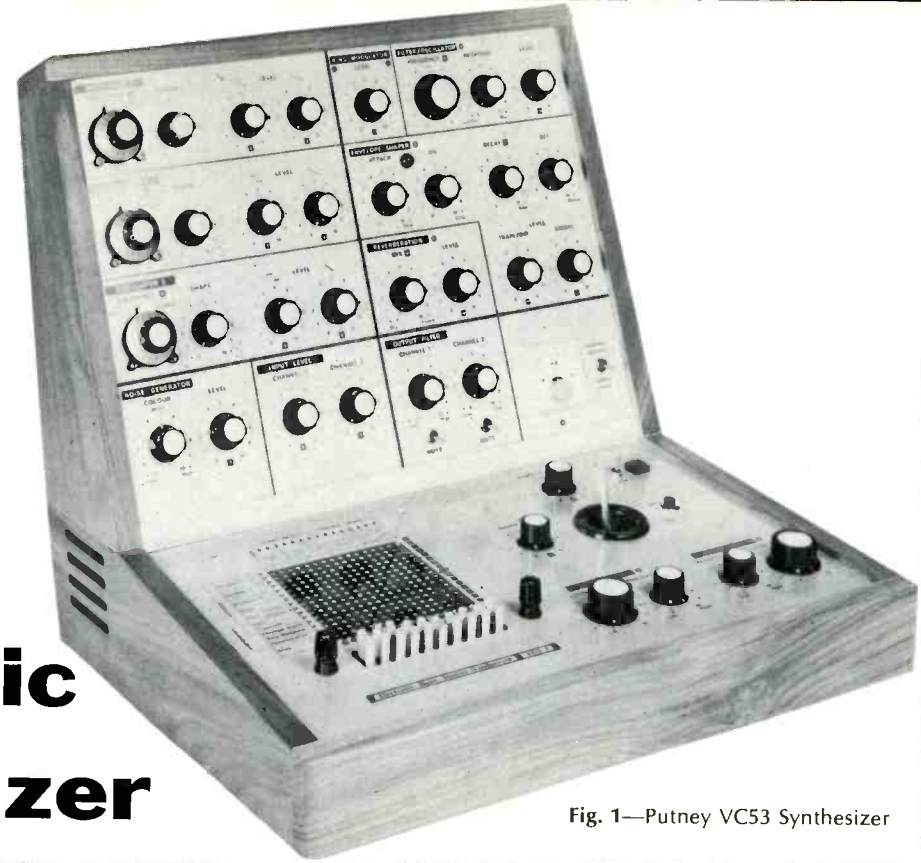

Fig. 1—Putney VC53 Synthesizer

SOME TWO YEARS AGO, Leonard Bernstein predicted electronic music would replace the symphony orchestra as we know it. This, with all due respect, is an extreme view and most musicians would be inclined to agree with a prominent composer who said electronics would end up as "a new voice in the orchestra." However, whether you subscribe to one view or the other there is no doubt about one thing—electronic music is definitely here to stay. The tape recorder was of course responsible for its conception; when the tape was rewound all sorts of bloops and bleeps were heard and the queer noise started people thinking. Here was a new sound that did not exist till then and with this as a start and a recorder to keep track (sorry!) of the sound, composers experimented with natural sounds pieced together. This was called *musique concrete* and it was pioneered by composers such as Pierre Schaeffer in Paris. While experimenting with electronic simulated speech, the RCA Mk. II synthesizer was developed as a kind of offshot of the program. This unit—reputed to cost anywhere from half-a-million to a million and a half dollars is ensconced in Columbia university. It is the only one in existence and is now wearing out for lack of spare parts and will eventually be a 'ghost ship'. Offshoots of this initial venture (which was pioneered by Milton Babbit) are the Moog synthesizor and Buchla systems. Some time ago, Harold Schonberg said if the price of a synthesizer could be brought down to the $3,000 to $10,000 range, every high school and college would have one in three years. Further evidence of the impact in the field was the astonishing popularity of "Switched on Bach" which presented a known and familiar work in the new medium. Today's young people are very enthusiastic about electronic music although many in their enthusiasm to break new ground want to go further and reject the past completely. I feel we must *build* on the past and not just dismiss it as being of no account. Many authorities have expressed the opinion that in order to be a proper candidate for electronic-compositional study, one should be able to demonstrate an understanding and some proficiency of the orchestral sound and score. We just cannot push buttons and get answers. One must have a *feel* for the combinations of sounds and tone-colors—in other words, the human element is still necessary in the mesh of all the electronic gear and gadgetry.

I suspect many musical people are frightened at first by some of the extreme sounds that emanate from synthesizers. Put anyone near one and the first thing he wants to do is see how fast and high or low he can make the gadget sound. His efforts bloop, bleep all over the lot and do not exactly win friends. However, whether we accept it or not, the synthesizer is here to stay and we ought to look at it a little more carefully and judiciously. It has been said that the synthesizer can do all the things a regular instrumentalist can do and more. To start with, the range goes beyond the limits of human hearing in both directions. Through the magic of voltage control the multitude of possibilities is almost limitless. Compare a synthesizer to say, an organ. On an organ, you press a stop and get one set sound. On the synthesizer with voltage control you can make every sound variable in just about every manner you can imagine. You can change the pitch, the timbre, the attack, the delay; there are so many possibilities—everything can be modified, altered, and varied. Just about any and every sound can be programmed on a synthesizer; whether it be a musical sound or noise. Sirens, the wind, thunder, lightning, trains, motors, cars, horns, and multitudes of sound effects all in a little box. A sound effects man can just go out of his mind dreaming up all the new sounds he can generate on a voltage control unit. Conventional instruments can still be played through a synthesizer and modified. With ring modulators, filters, envelopes, and trapezoids, your instrument or voice can now take on new dimensions. Here is something to think about: at maximum, an individual with 10 fingers and two feet can sound 12 tones. With

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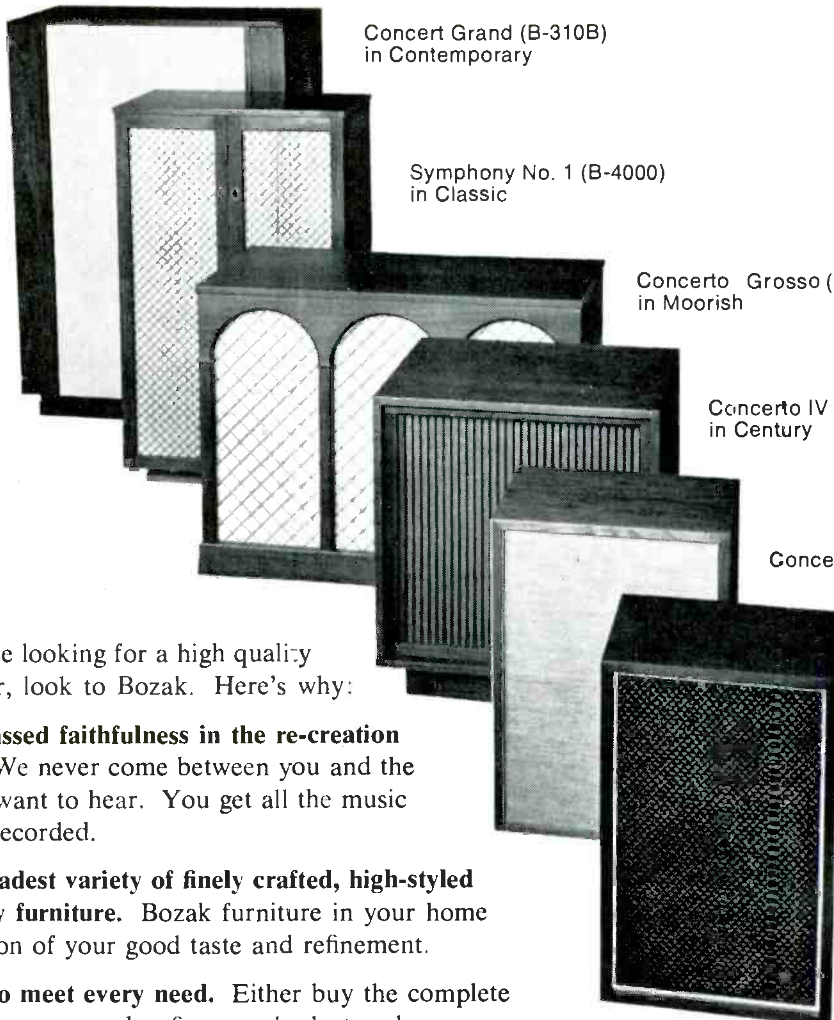

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electronic devices as many tones can be sounded as the listener can comprehend, they can produce any number of rhythms simultaneously, accurately and with absolute calm and ease.

The Putney VCS3 Studio as shown in the picture is unique in that it uses no patch cords but has a matrix of 256 points that provide plotting positions numerically and alphabetically like a map reference (B12, C4 for example). This means that perforated templates can be marked with selected locations and placed in position over the matrix board. Complete records can be maintained in manuscript books provided. The choice of controls, whether a joystick, attack buttons or optional keyboards make for utmost flexibility and the unit can also be used with a computer. Three oscillators are incorporated with a range of .05 Hz to 20 kHz and they offer a variety of waveforms including sine, ramp, saw tooth, square, and triangular. A slow-motion dial gives a wide range of timbres and a noise generator has amplitude and coloration controls so that various bandwidths of noise can be obtained at any level. A trapezoid output provides another shape or waveform normally in the low frequencies but also used in the attack and delay facility. Treatments include an envelope generator (attack, delay) which has an 'off-time' control so that the envelope can either be automatic or manually controlled by the attack button. Other features are a spring reverberation unit, a ring modulator and a filter. This last named device has a variable 'Q' control which can narrow the bandwidth right up to the point when oscillation occurs so that it can be used as an additional sine-wave generator, if so desired. As a filter, the cutoff rate is 12 dB-18 dB per octave in the range 5 Hz to 10 kHz. The input amplifiers each have level controls and the output amplifiers can be voltage controlled so that amplitude modulation and automatic 'fades' and 'crossfades' can be applied. Pan controls which cross the left channel to the right and vice versa are also on the panel. Manual control is obtained by means of the joystick as well as the attack button. The joystick can be used to control any function on the matrix, it can operate in either channel and it can be set up with one set of controls horizontally and another set vertically. The monitor speakers are built-in and are fed by 1-watt amplifiers. Line output is 2 x 2 V into 600 ohms and there are also 10-volt (50-ohm) outputs.

Figure 2 shows the No. 2 oscillator panel, the controls being frequency, shape, and two level controls for square and ramp waveforms. The shape control enables the waveform to be varied from asymmetrical (short pulse and sawtooth, Fig. 3a) through symmetrical, Fig. 3b, to a mirror image of the first position, Fig. 3c. The range of this oscillator is from one cycle to 10 kHz. Figure 4 shows the effect of mixing two waveforms, the ramp of No. 2 oscillator is combined with a higher level ramp from oscillator No. 3 to form a 'staircase' waveform. If this is applied to oscillator No. 1 this waveform will cause it to perform upwards or downward scales and arpeggios. Two-part chords and many other configurations can be produced by varying the controls accordingly. Space does not permit showing all the waveforms available but one we should not miss out is the *trapezoid*. Figure 5a shows the waveform and 5b shows what happens when this is combined with a single sine wave. Musically, this gliding tone is called a 'glissando' and it can be used with more complex configurations. Æ

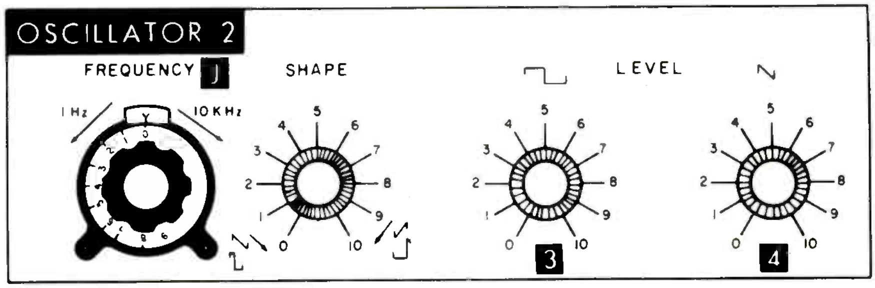


Fig. 2—Oscillator No. 2 control panel

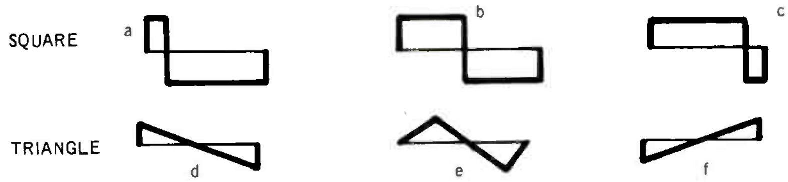


Fig. 3—Variations in waveform

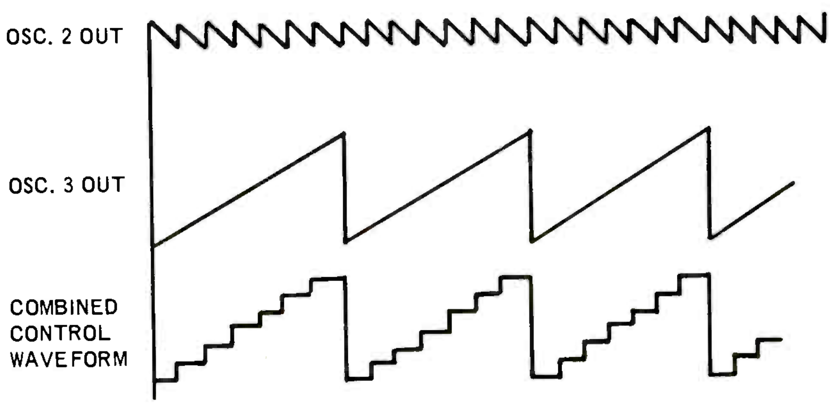


Fig. 4—Showing the effect of mixing two waveforms

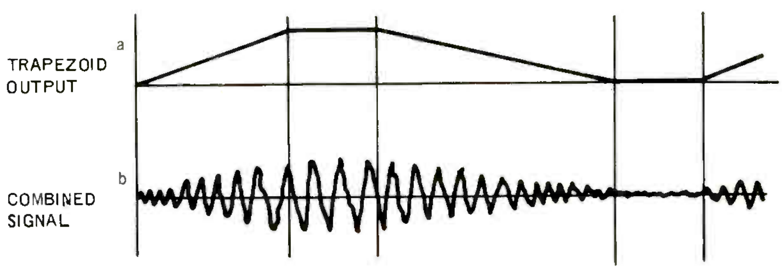
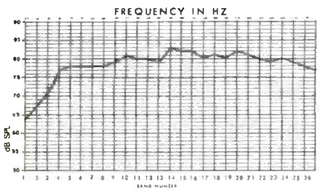
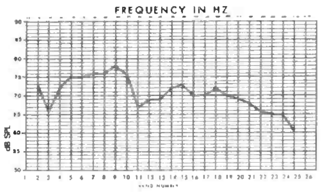


Fig. 5—Sine wave modulated by a trapezoid waveform

Every studio has its own ups and downs.

No two studios look alike in size, shape and location of speakers—in acoustic environment. So naturally no two studios look alike in frequency response either—in acoustic response.





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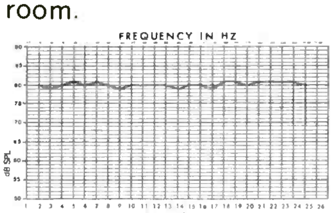

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Negative Feedback

NORMAN H. CROWHURST

To implement the design theorized in the previous installment, let's draw a schematic and start putting in values (Fig. 1). If we use a collector-to-base resistor for biasing, we make the output-stage current gain depend on output load. Instead, we'll use voltage-divider biasing, so the output stages may be considered as a voltage amplifier, rather than a current amplifier.

The collector load, as discussed in the theory of the previous installment, with nominal external load of 500 ohms and collector resistor of 1K, is 330 ohms. By making the emitter resistor 33 ohms, we set this stage's gain, with nominal load, at 10. Next we decide that the collector voltage should be one third the supply voltage. This will enable a maximum voltage and current swing to be delivered into the external 500-ohm load.

If supply voltage is 12 volts, collector voltage should be 4, with 8 volts, 8 mA in the collector resistor. With our assumed transistor parameters, average current gain 100, minimum 70, maximum 140, the base input current will average 80 microamps, with extremes of 56 and 112 microamps.

With 8 mA flowing through the 33-ohm emitter resistor, emitter voltage will be 0.264 volt. Base-to-ground current should be about 160 microamps, to swamp the 80-microamp average. A resistor of 1.5K will pass 175 microamps at 0.264 volt. The top resistor must drop 11.74 volts with the average 175 + 80 = 255 microamps, requiring a value of 47K.

Now to check what variation in current gain does. The bias resistors provide an open-circuit voltage of 1.5/48.5 x 12 = 0.37 volts, with a source resistance of

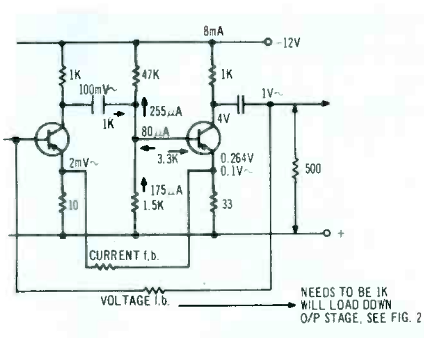

Fig. 1—Development of middle and last stages of amplifier.

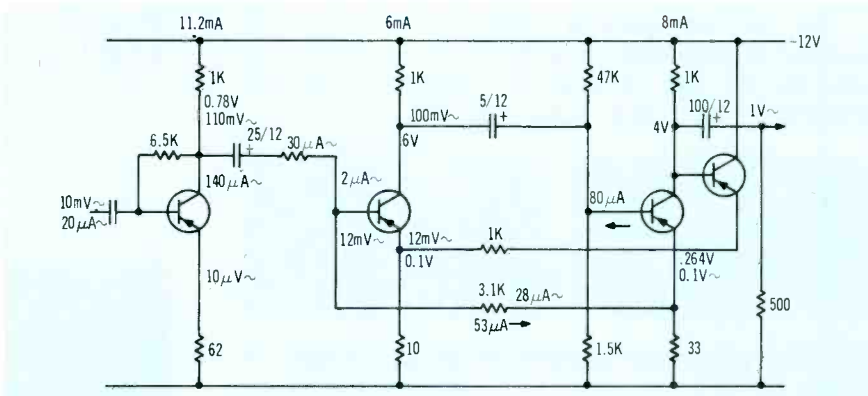

Fig. 2—Addition of emitter follower to avoid undesirable shunting effect by voltage feedback, and completion of this form of design.

1.5K in parallel with 47K, or 1.45K. When current gain is 70, the base input resistance is 70 x 33 = 2.3K, which will load the base voltage (which emitter voltage follows) down to (2.3/3.75) 0.37 = 0.226 V. Emitter current is 0.226/33 = 6.85 mA, collector voltage 12 − 6.85 = 5.15 V.

When current gain is 140, the base input resistance is 140 x 33 = 4.6K, which will load the base voltage down to (4.6/6.05) 0.37 = 0.28 V. Emitter current is 0.28/33 = 8.5 mA, collector voltage 12 − 8.5 = 3,5 V. This is probably an acceptable range of collector voltage variation, from 3.5 V to 5.15 V.

The input impedance at the base will average 100 times 33 ohms, or 3.3K. Paralleling this with the biasing resistors, 1.5K and 47K, results in an overall input impedance at this point of almost exactly 1K, with variation due to current gain, from 890 ohms to 1.1K. If this stage uses a 1K collector resistor, its collector load (to a.c. signal) will be 500 ohms, varying from 470 to 525 ohms.

If we use a 10-ohm emitter resistor on this stage, we can set its voltage gain to 50. Now let's put in some signal levels, to figure where we are, and to see what interaction we will get. Suppose the output voltage, with 500-ohm load, is 1 volt rms. Signal input to the output stage base will be 100 mV.

Without feedback, the signal voltage to the first stage (which is the middle stage of our three-stage amplifier) would be 1/50th of this, or 2mV. So the voltage feedback, fed in across 10 ohms, must be 5 times this, or 10 mV, raising the signal at emitter and base of this stage to 12mV.

Voltage feedback comes from the 1-volt output point, so the feedback resistor needs to be 990 ohms (1K will be near enough).

This won't do, because the 1K in parallel with the existing collector impedance will invalidate our calculations about it. To overcome this, we can use an emitter follower (Fig. 2). Direct coupling this to the output 1K will present a load of 100K (average) which will not materially disturb the 300 ohms nominal value. It will also transmit the 4-V (average) d.c. voltage, adding 4 mA to the current flowing through the 10-ohm resistor in the middle-stage emitter.

If we reckon on the middle stage taking 6 mA, so its collector voltage is 6 V, the total current in the emitter resistor is 10 mA (average) making the d.c. at this point 0.1 V.

Now we look to the middle-stage base for current feedback. Signal voltage, as already figured, will be 12 mV. Signal current, to produce 100 mV at the collector, with 200 microamps signal current, will average 2 microamps. Voltage feedback should be 14 times this, or 28 microamps, with a signal voltage difference of 100 − 12 = 88 mV. This combination requires a resistor of 3.1K.

Now to figure the d.c. working condition of the middle stage. The output-stage emitter voltage is 0.264 V (average). The middle-stage emitter voltage is 0.1 V. So the current feedback resistor will have 0.164 V across it, passing 53 microamps. The average bias current required by this stage is 60 microamps, so this should be adequate to maintain this transistor in its operating range.

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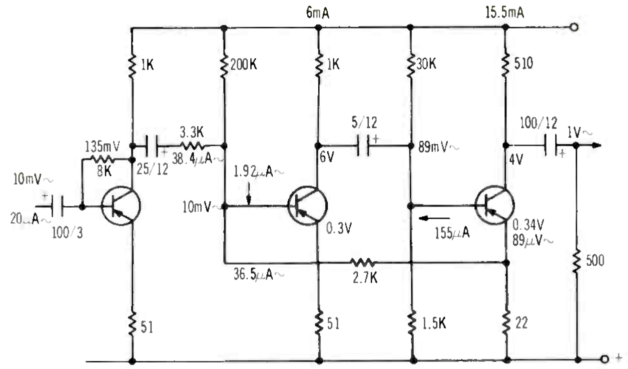


Fig. 3—Eliminating the need for voltage feedback by using different collector resistor.

At this point, signal, with nominal output load, is 12 mV at 30 microamps, representing an impedance of 400 ohms. When output is short-circuited, voltage feedback disappears, so signal is 2 mV at 30 microamps, representing an impedance of 67 ohms. When output is open-circuited, feedback voltage will be 3 times as great, or 36 mV, representing 1.2K.

To swamp this variation in input impedance of the middle stage so it receives substantially constant current from the first stage, a coupling resistor of 3.3K, rather than the 1K suggested in the previous installment, should be used. We have gain enough to spare. Now we redesign the first stage.

With a signal current of 30 microamps at 110 mV (the input end of the 3.3K resistor) and using a 1K resistor for the first-stage collector, signal current at this point will be 140 microamps. Now we decide the input should be 500 ohms, with input voltage 10 mV, current 20 microamps, which will represent 40 dB insertion gain.

To get 140 microamps collector signal current, the base input signal current needs to be 1.4 microamps (average rms). So the feedback resistor must take the other 18.6 microamps, incidentally increasing collector signal current to 158.7 microamps. This resistor passes 18.6 microamps with a signal voltage of 10 + 110 = 120 mV (phase reversal in stage), requiring a value of 6.5K.

Assuming current gain is 100, the d.c. resistance of the transistor at operating point will be 1/100th of 6.5K—about 65 ohms. In series with a 1K collector resistor, this sets the collector-to-emitter voltage at 0.065 x 12 = 0.78 V, which is plenty for handling a 10 mV signal. Now for the emitter resistor.

The drop must be 10 mV signal with signal current 158.7 microamps, requiring 63 ohms. A 62-ohm resistor will probably serve. That was a good exercise in figuring out a fairly complicated feedback situation. But if we look closer, there is a simpler way: why not use a 500-ohm collector resistor on the output stage, so no voltage feedback is needed, then apply 26 dB of current feedback?

We use (Fig. 3) a 510-ohm collector resistor, again with 4 V at the collector (based on average current gain of 100). Using a 22-ohm emitter resistor, with 250 ohms collector load, the stage voltage gain is 11.3. Collector current is 15.5 mA, emitter voltage 0.34 V.

Base current will average 155 microamps. A base-to-ground resistor of 1.5K, with 0.34 V will average an additional 227 microamps, totalling 383 microamps, with 11.66 V, requiring 30K for the top resistor. Base input resistance is 2.2K paralleled by 1.5K and 30K, resultant 865 ohms. Now a 1K collector resistor makes a collector load of 463 ohms.

If we use a 51-ohm emitter resistor, the voltage gain is about 9, so the two-stage gain (middle and output)is close to 100. Now for current feedback.

The output emitter will have a signal voltage (for 1 V output) of 1/11.3 = 89 mV. Previous stage emitter and base will have, in opposite phase, 10 mV. Total 99 mV—near enough 100 mV. Middle-stage collector signal current, into 463 ohms, at 89 mV, must be 192 microamps. So required base input signal current must average 1.92 microamps. To get 26 dB feedback, the feedback resistor must take 19 times this, or 36.5 microamps.

A current of 36.5 microamps, and a voltage of 100 mV, requires a resistor of 2.7K. This will stabilize the gain of these stages and linearize gain tremendously. Now for this stage bias. Output emitter 0.34 V, previous stage, with 6 mA, 0.3 V d.c. We may consider these voltages as the same, essentially, in which case no d.c. flows either way. Actually a small d.c. will flow, to compensate for d.c. gain deviations.

The base bias current requires to be 60 microamps, with which assumption, variation between 70 and 140 for middle-stage gain will keep collector voltage well within operating range, and bias resistor drops 11.7 V, requiring a value of 200K.

Signal input to the middle stage is now 38.4 microamps at 10 mV, representing an impedance of 260 ohms. Again using a 3.3K 'padder', this drops a signal voltage of 125 mV, making 135 mV signal at this collector. A 1K collector resistor will take 135 microamps signal current, making a total at this point of 174 microamps from the first stage.

Again setting the 10-mV, 20-microamp signal input requirement, base input current needs to be 1.74 microamps, feedback current 18.26 microamps, voltage across the resistor 135 + 10 = 145 mV. Value 8K. Emitter resistor signal current 192 microamps, voltage 10 mV, value 52 (use 51) ohms.

This circuit allows plenty of margin for the predicted gain variations. Finally we need to put in capacitor values. Assuming the 3-dB low-frequency point should be 2 Hz, the output coupling capacitor should have a reactance no greater than 1K at 2 Hz, which would require 80 μF. A 100-μF, 12-V capacitor will serve in both circuits.

For the interstage in the circuit of Fig. 2, the capacitor feeds between 1K resistors again, so it needs to have a reactance of 2K maximum at 20 Hz. We want full distortion reduction down to 20 Hz, and the 26-dB feedback will ex-

(Continued on page 71)

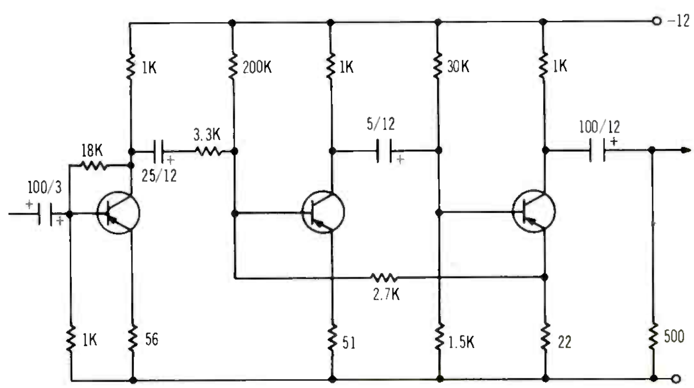


Fig. 4—Change of input circuit to avoid possible blocking by input overloading.

Why BOSE eliminates woofers, tweeters and CROSSOVERS

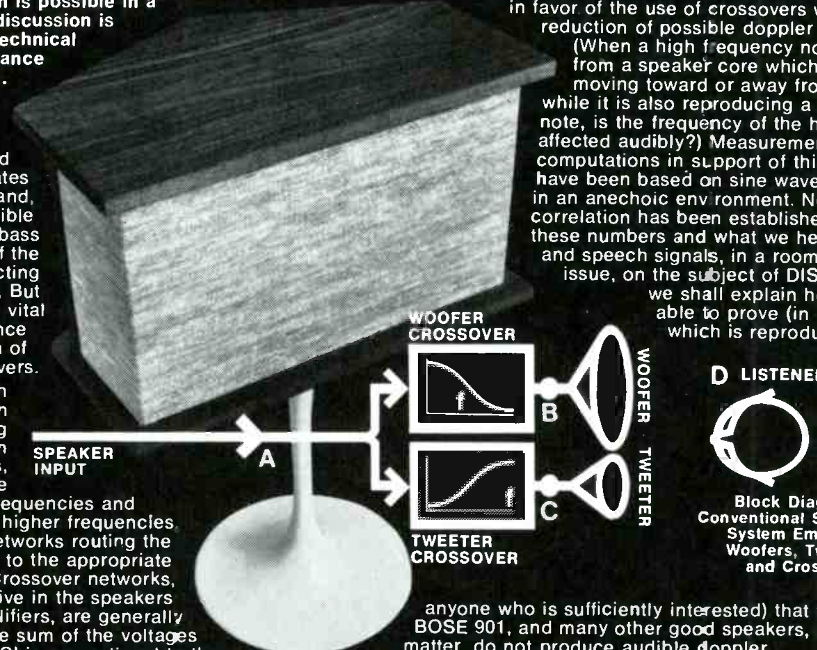
If you have heard the BOSE 901 Direct/Reflecting™ speaker system or if you have read the unprecedented series of rave reviews in the high fidelity publications, you already know that the 901 is the longest step forward in speaker design in perhaps two decades. Since the superiority of the 901 (covered by patents issued and pending) derives from an *interrelated group of advances*, each depending on the others for its full potential, we hope you will be interested in a fuller explanation than is possible in a single issue. This discussion is one of a series on the technical basis of the performance of the BOSE 901.

In other issues we describe how a multiplicity of same-size, acoustically coupled speakers eliminates audible resonances and, in addition, makes possible the unprecedented bass performance of the BOSE 901 Direct/Reflecting speaker system. But there is yet another vital benefit from this advance — the elimination of crossovers.

The best answer which had previously been found, for reproducing the full audio spectrum with dynamic speakers, was the use of a large speaker for the bass frequencies and smaller speakers for the higher frequencies with crossover networks routing the appropriate frequencies to the appropriate speakers. (see fig.) Crossover networks, whether they are passive in the speakers or electronic in amplifiers, are generally designed so that the sum of the voltages at 'B' and 'C' is proportional to the speaker input signal at 'A'. This would be adequate only if the speakers were themselves perfect for then we might have an acoustical signal at 'D' which bore a close relation to the speaker input 'A'. However, woofers and tweeters are far from ideal. They exhibit both phase and amplitude irregularities in the crossover region. Phase differences between the woofer and tweeter, for example, can cause the cone of the woofer to advance while the cone of the tweeter is retreating. The result is sound coloration caused by the fact that the sum of the output of the woofers and tweeters is widely varying in the region of the crossover frequencies.

Equally important, the directionality (dispersion) of a speaker varies with its diameter. Therefore, the spatial characteristics of the sound can change sharply in the crossover region as the radiation shifts from the large woofer to the small tweeter. "This spatial property of the sound incident upon a listener is a parameter ranking in importance with the frequency spectrum . . . for the subjective appreciation of music."*

The principal reason which had been put forth in favor of the use of crossovers was the reduction of possible doppler distortion. (When a high frequency note is emitted from a speaker core which is 'slowly' moving toward or away from the listener while it is also reproducing a bass note, is the frequency of the higher note affected audibly?) Measurements and computations in support of this hypothesis have been based on sine waves, on one axis, in an anechoic environment. No correlation has been established between these numbers and what we hear with music and speech signals, in a room. In another issue, on the subject of DISTORTION, we shall explain how we were able to prove (in an experiment which is reproducible by anyone who is sufficiently interested) that the BOSE 901, and many other good speakers, for that matter, do not produce audible doppler distortion on music or speech.



Block Diagram of Conventional Speaker System Employing Woofers, Tweeters and Crossovers.

If you would like to hear the performance of a speaker with no woofers, tweeters or crossovers (and several other major advances), ask your franchised BOSE dealer for an A – B comparison of the BOSE 901 with the best conventional speakers he carries— *regardless of their size or price.*

***From 'ON THE DESIGN, MEASUREMENT AND EVALUATION OF LOUDSPEAKERS', Dr. A. G. Bose, a paper presented at the 1968 convention of the Audio Engineering Society. Copies of the complete paper are available from the Bose Corp. for fifty cents.**

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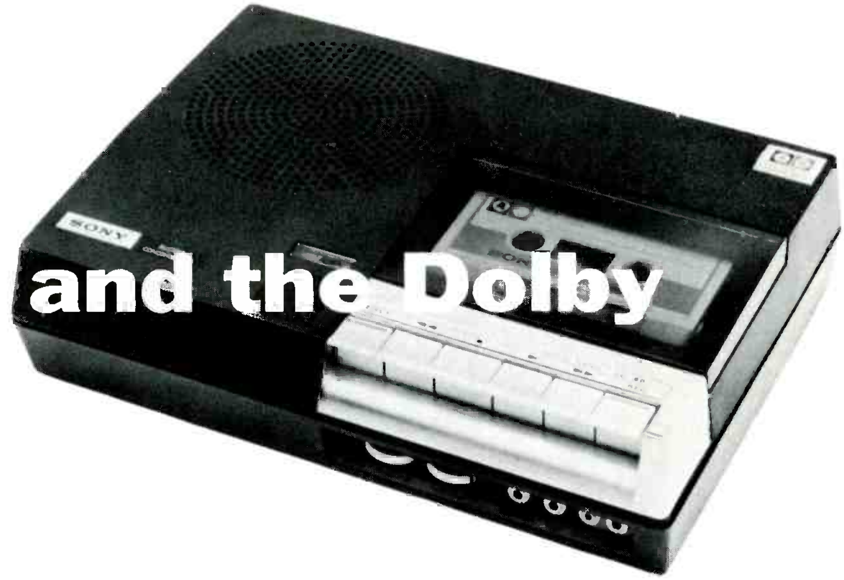
Cassettes and the Dolby System



Among themselves engineers sometimes use a special superlative that says more than all the supers and ultras you will ever hear: *state of the art.* It is a sober term, and woe to the professional who uses it unwisely and too well. In this early spring of 1970, some of us have just heard the sound of a state-of-the-art cassette. No more was claimed—but the impact of the low-key demonstration was awesome. Here, it would seem, is the beginning of a major turn in consumer or "home" type recordings of all sorts, and one again the durable disk is threatened. The cassette may soon *sound* better.

This is the more interesting because for its special cassettes Advent (a very busy young company these days) has brought together two major recent developments long since separately hailed in this magazine—the Dolby noise reduction system, in its new "B" (for home audio equipment) circuitry, and that fabulous black Dupont Crolyn chromium-dioxide tape which is still officially non-existent in audio but is appearing all over the place *sub rosa,* short of the actual consumer market.

As we all know, the cassette has made it, after a surprisingly long gestation since Philips introduced it in Europe. It's booming. But present cassette dogma is positive: the system, for all its convenience and compactness, is with its 1⅞-ips speed and tiny, narrow tape strictly not for hi fi. Tonal range is punk to so-so. Dynamic range is limited. Distortion and mechanical wow-and-flutter are mostly too high for serious hi fi listening. (Try a piano!) Worst of all, juggling of recording parameters results in entirely too much hiss, which is omnipresent and apparently as unavoidable as record scratch in 78-rpm disk days. The cassette, then, is mainly for ultra-convenient speech recording and for not-so-hi-fi music. The audiophile isn't touching it.

Curiously, manufacturers under these circumstances cannot afford to build solid quality into existing cassette players, as they do, for instance, into the better automatic disk players. Serious listeners simply will not pay for it. And thus flimsy equipment leads to more flimsy sound. A vicious circle indeed.

It is this sort of dogma which the Advent people undertook to refute by example. How astonishing to hear them state, matter-of-factly, that the cassette can *remove* the quality limitations inherent in the state-of-the-art *disk* recording! The limitations, they say, aren't in the cassette at all. On the contrary, the cassette at last opens up new horizons for technical improvement.

We heard the evidence via a series of A-B tests in which familiar recordings were deftly compared, in conventional disk format, via standard commercial cassettes and in the specially made state-of-the-art cassettes, produced (like disk recordings) from tapes copied from recording-company masters. Time after time, the new cassette sound easily equalled, or even surpassed, the best disk sound in vital respects. Frequency range and low distortion. Dynamic range. Wow and flutter. And, most important, low background noise. Velvet silence! Who has ever heard *that* from a cassette! These had it.

No one factor was responsible and this was Advent's intent. This was a careful adding-up of many virtues, out of painstaking efforts to improve *all* aspects of cassette performance within the standard parameters. But Crolyn and Dolby were clearly the big news. At the very slow speed Crolyn gives perhaps a 6-dB advantage in noise over top-quality iron-oxide tape and an easily wider tonal range —hence a cleaner, more satisfactory signal. The Dolby "B" circuit drops the noise level in a different fashion, by 10 or 15 dB without the slightest observable effect on the musical signal. (My ears vouch for that, as they did for the original pro "A" circuitry.) A carefully chosen commercial cassette player, a production model, took care of the wow and flutter. (Nameless, because not all of its examples are quite as good.) If you can do it once, you can do it again, was my thought.

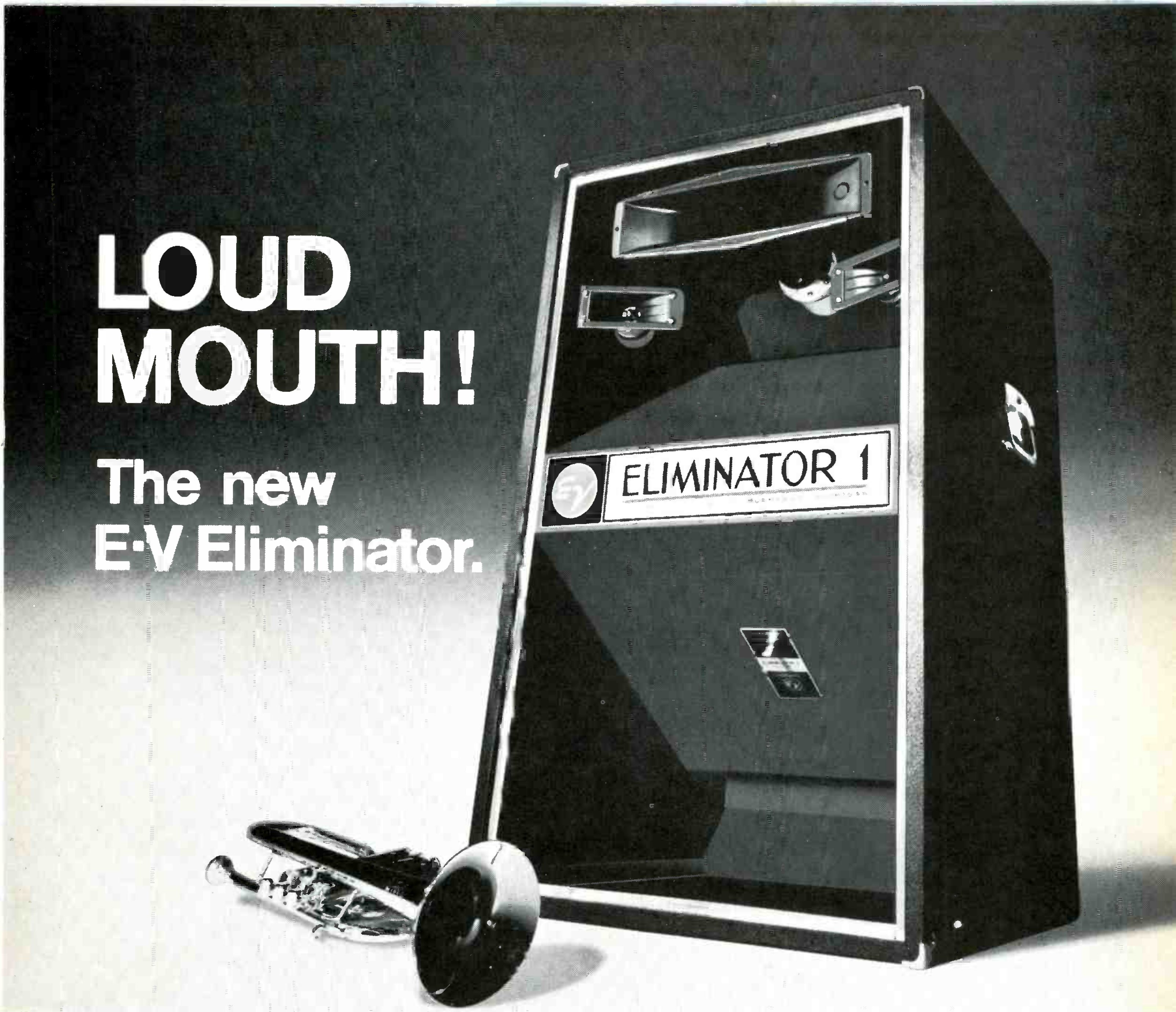
To answer an inevitable question—how about mass production?—Advent sent out a Dolby-treated tape for commercial processing, onto non-Crolyn BASF tape, via high-speed duplicating equipment exactly as in a standard production cassette. Even so, played back through the Dolby circuit the sound was markedly better than that of the very same recording played normally from a commercial cassette release. And the noise improvement was fantastic. Cassette advancement must be many-faceted but even one major element can tip our scales heavily towards a change of thinking.

The disk, to be sure, is not yet dead and won't die so long as its cost, quality, and ease of handling remain important. But the handy little boxes of tape are going to offer formidable competition to all forms of disk, right up to the top, and simultaneously to every kind of home reel-to-reel tape, a system that is already reeling, shall we say, under the impact of increased cassette sales.

So this miniaturized tape, you must now understand, is likely to be *the* medium for home hi fi some day, give or take a few years. As one good soul put it after the state-of-the-art demonstration, only a single problem still remains hopelessly insoluble. Where do we put the program notes? Not even Dolby can answer that one. Æ

LOUD MOUTH!

The new E-V Eliminator.



The first Eliminator was built to prove a point. Because young musicians, in a search for more volume, were literally driving the guts out of some very good speakers mounted in some very poor enclosures.

It started an intensive investigation into the failure of speakers (ours and the competition) used by guitars and organs. The testing was very rugged. For instance, we took miles of high-speed motion pictures while test speakers destroyed themselves with sound.

We found out a lot about how to improve our speakers. But we also learned that by simply putting our SRO/15 speaker in a folded horn enclosure we created a combination that was unbeatable for efficiency, high power handling capacity, low distortion, and extended bass. It was an important first step.

Of course, this now meant we needed a solid high end. So we added the time-tested 1829 treble driver and 8HD horn, or (optionally) a T25A treble driver plus a pair of T35 super tweeters. These combinations were a revelation to musicians. They got more sound power per watt than they thought possible. And they could use the Eliminator for both vocals or instruments.

But we weren't quite satisfied. If the Eliminator was good for popular music, what would it do with other kinds of program material? So we tested it in good rooms and bad rooms. With test instruments and with live audiences. And we decided that the Eliminator was too good to sell only to the young.

For example, in one test installation in a difficult domed building, four E-V Eliminator I speakers far out performed an elaborate multicell installation in naturalness of sound for voice and music, in uniform sound pressure level throughout the listening area, and in the ability to reproduce the extremes of loudness of a big, driving jazz band with ease.

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LOS ANGELES HILTON HOTEL

930 Wilshire Boulevard, Los Angeles, Calif.

SCHEDULE OF EVENTS

Sunday, May 3 — 10:00 a.m. Exhibitors Breakfast
Los Angeles Room
5:00-7:00 p.m. No-Host Welcoming Cocktail Party
Sierra Room

REGISTRATION

Monday, May 4—8:00 a.m. to 5:00 p.m. **Tuesday, May 5**—9:00 a.m. to 8:00 p.m.
Wednesday, May 6—9:00 a.m. to 5:00 p.m. **Thursday, May 7**—9:00 a.m. to 8:00 p.m.

EXHIBIT HOURS

Monday and Tuesday—1:00 p.m. to 9:00 p.m. **Wednesday and Thursday**—11:00 a.m. to 5:00 p.m.

DEMONSTRATION ROOMS

Mission, Cleveland, Washington, Detroit, Buffalo, Boston, St. Louis, and Troy Rooms

TECHNICAL SESSIONS

Golden State Room: Sessions A, C, E, F, G, J, K, L, M, and O.
Los Angeles Room: Sessions B, D, H, N, and P.

Monday, May 4	9:30 a.m.	Sessions A & B
	2:00 p.m.	Sessions C & D
	No sessions Monday evening	
Tuesday, May 5	9:30 a.m.	E
	2:00 p.m.	F
	7:30 p.m.	G & H
Wednesday, May 6	9:30 a.m.	J
	2:00 p.m.	K
Social Hour	**7:00 p.m.**	**Los Angeles Room**
Awards Banquet	**8:00 p.m.**	**Golden State Room**
Thursday, May 7	9:30 a.m.	L
	2:00 p.m.	M
	2:20 p.m.*	N
	7:30 p.m.	O, P, & Q

LADIES' ACTIVITIES

Many and various activities have been arranged for the ladies, who may join the hostess and her committee in the New York room at 9:00 a.m. each day for coffee and sweet rolls before commencing the day's activities.

THE TECHNICAL PAPERS

For readers unable to attend, many of these papers can be had in preprint form (50¢ ea., AES members; 85¢ ea. non-members) from Audio Engineering Society, Inc., Room 248, The Lincoln Building, 60 E. 42nd St., New York, N.Y. 10017. Write for list of available titles.

Monday, May 4: (9:30 a.m.)

MOTION PICTURE SOUND TECHNIQUES

Chairman: Joseph D. Kelly, Glen Glenn Sound, Hollywood, California

A1 A new production sound dolly and automated transfer unit
Elliot Bliss, CBS Studio Center, Studio City, California

A2 Re-recording process
James G. Stewart, Glen Glenn Sound Co., Hollywood, California

A3 The sound re-recording console
Barry K. Henley, Glen Glenn Sound Co., Hollywood, California

A4 Film recording equipment, as installed at the American Zoetrope Company—San Francisco, California
K. Kenneth Miura, Dept. of Cinema, University of Southern California, Los Angeles, California

A5 A new sprocket driven audio recorder/reproducer
Donald R. Collins, Tele-Cine Inc., New York, New York

A6 An electronic looping system
Otto Popelka and Norman Prisament, Magna-Tech Electronic Company, Inc., New York, New York

Monday, May 4: (9:30 a.m.)

ACOUSTICAL NOISE AND NOISE CONTROL

Chairman: Kenneth M. Eldred, Wyle Laboratories, El Segundo, California

B1 Some problems and successes in controlling noise exposure in California industry
William W. Steffan, Division of Industrial Safety, State of California, San Francisco, California

B2 A systems approach to aircraft noise control
Daniel W. Emory, Daniel W. Emory & Associates, Newport Beach, California

B3 The motor vehicle noise problem and what is being done about it
Ross A. Little, Engineering Section, California Highway Patrol, Sacramento, California

B4 Measurement of traffic noise on Connecticut highways
Gerald A. Budelman and Edward J. Foster, CBS Laboratories, Stamford, Conn.

B5 Needs and specifications for audio equipment used in psycho-acoustic work
Lawrence E. Langdon, McDonnell Douglas Corporation, Douglas Aircraft Co., Long Beach, California

B6 An automatic highway noise monitor
Richard G. Allen, Thomas P. Owen and Emil L. Torick, CBS Laboratories, Stamford, Connecticut

Monday, May 4:
(2:00 p.m.)
DISC RECORDING AND REPRODUCTION

Chairman: Stephen F. Temmer, Gotham Audio Corporation, New York, N.Y.

C1 Development and application of a new "Tracing Simulator"
Dieter Braschoss, George Neumann, Electroacustic GmbH, Berlin, Translated and read by Stephen F. Temmer, Gotham Audio Corporation, New York, N.Y.

C2 Interaction between tracing and deformation errors
Duane H. Cooper, University of Illinois, Urbana, Illinois

C3 An evaluation of the forces required to move a tone arm
John J. Bubbers, Stanton Magnetics Inc., Plainview, New York,

C4 Maximum levels in the record/playback system
Arnold Schwartz, Micro-Point, Inc., White Plains, New York

C5 The compatible stereo generator and its application to all stereo media
Howard S. Holzer, Holzer Audio Engineering Corporation, Van Nuys, California

Monday, May 4:
(2:00 p.m.)
AUDIO IN AM, FM, AND TV BROADCASTING

Chairman: Richard W. Burden, Richard W. Burden Associates, Mt. Kisco, New York

D1 Transmission of additional aural channels on a television carrier
John A. Moseley, Moseley Associates, Inc., Goleta, Calif.

D2 Report on possible multiplex methods for the transmission of four-channel FM stereo
W. S. Halstead, Multiplex Development Corp. and RTV International, New York, N.Y.

D3 A review of program-level-indicating systems
John G. McKnight, Ampex Stereo Tapes Division, Redwood City, California

D4 Read-out devices other than the standard VU Meter as a better means of measuring peak levels.
LeRoy C. Granlund, Western Broadcasting Services, Sunnyvale, Calif.

D5 Panel Discussion: Review and discussion of the problem areas of peak levels and loudness control and measurement.
Moderator: Richard W. Burden, Burden Associates, New York
Panelists: John G. McKnight, Ampex Corporation, Redwood City, Calif.; Bernard Katz, B & K Instruments, Cleveland, Ohio; Arna Meyer Belar, Belar Associates.

AES Exhibitors

Manufacturer	Booth No.
Accurate Sound Co.	57
Agfa-Gevaert, Inc.	56
AKG Div., North American Philips Corp.	141/142
Altec Lansing	105/106
Ampex Corporation	92-96
Artisan Sound Recorders (Buffalo Rm.)	Demo Rm. F
Audio Designs & Manufacturing, Inc.	118/119
Automated Processes Inc.	49
B & K Instruments, Inc.	59
The R. T. Bozak Mfg. Company	98
David Clark Company Inc.	63
Carl Countryman & Associates	117
Crown International	29
Custom Fidelity, Inc.	61
D. B. Audio Corporation	60
Dolby Laboratories, Inc.	67/68
Dukane Corporation	112
Electrodyne Corporation	110/111
Electro Sound, Inc.	25-28
Electro-Voice, Inc. (Mission Rm.)	Demo Rm. A
Fairchild Sound Equipment Corp.	7/8
Daniel N. Flickinger & Associates	3
Gately Electronics	52
Gauss Electrophysics, Div. MCA Technology	122/123, 129/130 (Cleveland Rm.) Demo Rm. B
Gotham Audio Corporation	113-116
GRT Corporation	70/71/72
Harvey Radio Company, Inc.	10/11
Hewlett-Packard	5/6
Holzer Audio Engineering Corp. (Washington Rm.)	Demo Rm. C
Infonics, Inc.	55
Koss Electronics, Inc.	41
Langevin Co., Inc.	40
James B. Lansing Sound, Inc. (Foy Rm.)	Demo Rm. K
Lipps, Inc.	51
Magnetic Recording Systems, Inc.	54
Melcor Electronics Corporation	1/2
Metrotech Incorporated	108/109, 120/121
R. A. Moog, Inc.	69
Moser Development Company	136/137
Johnson Industries	
Broneer Engineering	
Nagra Magnetic Recorders, Inc.	58
Opamp Laboratories	20
Otari of America, Ltd.	124/125
Parasound, Inc.	69
Pentagon Industries, Inc.	4
Philips Broadcast Equipment Corp. (Detroit Rm.)	Demo Rm. D/50
Quad-Eight Sound Corporation	89/90/91
Sarex Corporation	140
Scientific Electronic Systems	62
Scully Recording Instruments Co.	108/109, 120/121
Sennheiser Electronic Corp. (N.Y.)	97
Shure Brothers, Incorporated	104
Sonic Arts Corp.	53
Spectra-Sonics	138/139
Stanton Magnetics, Inc.	107
Superscope, Inc.	30/31
Systron-Donner, Microwave Division	34
Taber Mfg. and Engrg. Company	103
Tannoy (America) Ltd. (St. Louis Rm.)	Demo Rm. J
3M Company	126-128, 133-135
Tonus, Inc. (Boston Rm.)	Demo Rm. E
United Recording Electronics Industries	131/132
Universal Audio	
Waveforms	
United Research Laboratory Corp.	45
Value Engineering Company	21
Vega Electronics Corporation	65/66
Wiegand Audio Laboratories	13/14

D6 Microphone recordings for radio and TV when loudspeaker equipment is simultaneously used for an audience
Ernst-Joachim Voelker, Stierstadt/Taunus, West Germany

Tuesday, May 5:
(9:30 a.m.)
MICROPHONES AND PLAYBACK CARTRIDGES

Chairman: Robert W. Carr, Shure Brothers Inc., Evanston, Illinois

E1 Miniature electret microphones
Freeman W. Fraim and Preston V. Murphy, Thermo Electron Corporation, Waltham, Massachusetts

E2 Third-order-gradient microphone for speech reception
B. R. Beavers and R. Brown, LTV Research Center, Anaheim, California

E3 Experimental wide-bandwidth tooth-contact microphone
Austin J. Brouns, LTV Research Center, Anaheim, California

E4 Microphone accessory shock mount for stand or boom use
Gerald W. Plice, Shure Brothers, Evanston, Illinois

E5 Closing the wireless-versus-wired microphone-dependability gap
Barry M. Kaufman, Vega Electronics, Santa Clara, California

E6 Bi-radial and spherical stylus performance in a broadcast disk reproducer
J. R. Sank, RCA, Camden, New Jersey

E7 New directions in microphone placement
Jim Cunningham, 8-Track Recording Company, Chicago, Illinois

Tuesday, May 5:
(2:00 p.m.)
LOUDSPEAKERS

Chairman: Richard C. Heyser, Jet Propulsion Laboratories, Pasadena, California

F1 Loudspeaker measurement techniques
Charles L. McShane, Acoustic Research Inc., Cambridge, Massachusetts

F2 Some observations and speculations on the role of speakers in stereophonic reproduction
Dr. Joel C. Finegan, 3M Co., St. Paul, Minnesota

F3 The inter-relationship of cabinet volume, low-frequency resonance, and efficiency for acoustic-suspension systems
Dr. Joel C. Finegan, 3M Co., St. Paul, Minnesota

F4 Acoustical circuits revisited
Dr. Robert Howard, James B. Lansing Co., Los Angeles, California

F5 Time-delay distortion in multi-speaker systems
Martin Gersten, Rectilinear Research Corp., New York, New York

F6 Wisdom and witchcraft of old wives tales about woofer baffles
Dr. J. Robert Ashley and Thomas A. Saponas, University of Colorado, Colorado Springs, Colorado

Tuesday, May 5: (7:30 p.m.)

ELECTRONICS APPLIED TO MUSIC

Chairman: Dr. Jody C. Hall, Thomas Organ Company, Sepulveda, California

G1 Techniques of generating and gating source signals in modern electronic organs.
Allan E. Winsberg, Thomas Organ Company, Sepulveda, California

G2 The electronic piano
Harold Rhodes, CBS Musical Instruments, Fullerton, California

G3 Changing pitch and timbre of woodwind instruments by electronic means
Brad Plunkett, United Recording Electronics Industries, North Hollywood, California

G4 A "ring-modulator" device for the performing musician
Thomas E. Oberheim, Oberheim Electronics, Inc., Santa Monica, California

G5 The use of the Buchla synthesizer in musical composition
Morton Subotnick, Consultant, CBS Musical Instruments, Fullerton, Calif.

G6 Demonstration of the practical application of electronics in music
Morton Subotnick, Allan Winsberg, Brad Plunkett, Thomas Oberheim, Harold Rhodes, and Dr. Jody C. Hall, Moderator

Tuesday, May 5: (7:30 p.m.)

AUDIO MEASUREMENTS AND INSTRUMENTATION

Chairman: Gerald G. Gross, Hewlet-Packard, Palo Alto, California

H1 An improved field corrector for free-field microphone calibrations
Edward J. Foster, Louis T. Fiore, and Benjamin B. Bauer, CBS Laboratories, Stamford, Connecticut

H2—Simplified spectral analysis by use of a band-limited random-noise test record
Robert R. Beavers, Atlec-Lansing, Anaheim, California

H3 Impulse-responsive adapter for chart recorder
Edward J. Foster and Benjamin B. Bauer, CBS Laboratories, Stamford, Connecticut

H4 Acoustic-impedance calibrator for mask and microphone measurements
A. J. Brouns and C. T. Morrow, LTV Research Center, Anaheim, California

H5 The measure of flutter in audio tape record/reproduce machines
R. A. Christner, Data Measurements Corporation, Palo Alto, Calif.

H6 Precision sound-level recording system for industrial environments
Gerald G. Gross and Wolfgang Giletsch, Hewlett-Packard, Palo Alto, California.

Wednesday, May 6: (9:30 a.m.)

ARCHITECTURAL ACCOUSTICS AND ELECTROACOUSTICS

Chairman: Michael Rettinger, Consultant on Acoustics, Encino, California

J1 Noise: The new pollutant. (Motion picture produced by The National Educational Television Network with a grant from the Acoustical Materials Assn.
NET Film Service, Indiana University, Bloomington, Indiana

J2 An historical and architectural review of opera halls of the world
Wilfred A. Malmlund, Bolt, Beranek and Newman, Inc., Van Nuys, California

J3 Microphone thermal-agitation noise
Dr. Harry F. Olson, David Sarnoff Research Center, RCA Laboratories, Princeton, New Jersey

J4 Planning of U.S. Air Force Audio-Visual Center, Norton Air Force Base, San Bernardino, California
Robert W. Houts, Sound Services Division, AF Audio Visual Center, Norton Air Force Base, California, and Michael Rettinger, Consultant on Acoustics, Encino, California

Wednesday, May 6: (2:00 p.m.)

SIGNAL CONTROL AND PROCESSING

Chairman: William P. Brandt, Altec-Lansing, Anaheim, California

K1 A new portable professional mixing console
George Alexandrovich, Sr., Fairchild Sound Equipment Corporation, Long Island City, N.Y.

K2 Modules . . . Why?
Oliver Berliner, SounDesign Engineers, Beverly Hills, California

K3 When is phase shift objectionable?
Robert A. Bushnell, Bushnell Electronics Corporation, Van Nuys, California

K4 Electronic adjustment of monitoring acoustics
Daniel N. Flickinger, Elektracoustics Division, Daniel N. Flickinger and Associates, Inc., Hudson, Ohio

K5 The stereo synthesizer and stereo matrix: New techniques for generating stereo space
Robert Orban, Kurt Orban Co., Inc., East Palo Alto, California

K6 The disclosure of hidden information in sound recording
E. Roerbaek Madsen, Bang & Olufsen A/S, Struer, Denmark

Thursday, May 7: (9:30 a.m.)

MAGNETIC RECORDING AND REPRODUCTION

Chairman: John T. Mullin, Mincom Division, 3M Co., Camarillo, California

L1 A new rotary-turret head-mounting system for multiple-track configurations
Pat Tobin, Program Dynamics, Inc., Los Angeles, California

L2 A standard vocabulary for audio tape duplicators
Haskell M. Metz, Otari of America, Ltd., Inglewood, California

L3 Development of a new magnetic tape for music mastering
Delos A. Eilers, 3M Company, Magnetic Products Division, St. Paul, Minnesota

L4 Measurements of mechanical properties of magnetic tape
Robert A. Finger, Patrick Murphy, and Edward J. Foster, CBS Laboratories, Stamford, Connecticut

L5 A drop-out perceptibility counter
Edward J. Foster, CBS Laboratories, Stamford, Connecticut

L6 Specifications for magnetic recording and reproducing heads and tapes
John G. McKnight, Stereo Tapes Division, Ampex Corp., Redwood City, California

L7 Musicassette interchangeability: The facts behind the facts
E. R. Hanson, North American Philips Corporation, New York, N.Y.

Thursday, May 7: (2:00 p.m.)

MUSIC, SPEECH, AND HEARING

Chairman: Dr. Leo L. Beranek, Bolt, Beranek and Newman, Inc., Cambridge, Massachusetts

M1 Growth of vocal output
Mark B. Gardner, Bell Telephone Laboratories, Inc., Murray Hill, New Jersey

M2 Application of rating scales to quantify subjective evaluations for a group of concert halls
B. G. Watters, R. Johnson, R. L. Kirkegaard, Bolt, Beranek and Newman, Inc., Cambridge, Massachusetts

M3 The simulation of moving sound sources
Dr. John Channing, Dept. of Music, Stanford University, Stanford, California

M4 A demonstration of moving sound sources
Dr. John Channing, Dept. of Music, Stanford University, Stanford, California

M5 Determination of an effective tone-ring signal
Richard M. Hunt, Bell Telephone Laboratories, Inc., Indianapolis, Indiana

M6 Simulating jet aircraft flyover noise for subjective judgments
Karl S. Pearsons, Bolt, Beranek and Newman, Inc., Van Nuys, Calif.

Thursday, May 7:
(2:30 p.m.)

AMPLIFIERS AND AUDIO CIRCUITRY

Chairman: John P. Jarvis, Consultant, Northridge, California

N1 Audio engineering and the publications group
Charles R. Norton, Altec-Lansing, Anaheim, California

N2 Eliminating r.f. from audio systems
Paul E. Gregg, Bauer Broadcast Products, Granger Associates, Palo Alto, California

N3 Operational amplifier implementation of ideal crossover networks
J. Robert Ashley and Lawrence H. Henne, University of Colorado, Colorado Springs Center, Colorado Springs, Colorado

N4 A low-noise approach to the mixer-stage amplifier
P. B. Spranger and J. Pritchett, Altec-Lansing, Anaheim, California

N5 A gain-reduction amplifier that employs a junction field-effect transistor as an active element of a resistive divider
John P. Jarvis, Northridge, California

Thursday, May 7:
(7:30 p.m.)

SOUND REINFORCEMENT

Chairman: Herbert M. Jaffe, Atlas Sound Division, American Trading and Production Corp., Parsippany, N.J.

O1 Design of a high-quality public-address system for aircraft use
Alan J. Rosenheck, Bolt, Beranek and Newman, Inc., Van Nuys, California and James D. Kronnan, Lockheed California Company, Burbank, California

O2 Acoustical treatment and sound reinforcing systems for the Washington State Legislature
Herbert T. Chaudiere, Robin M. Towne and Associates, Seattle, Washington

O3 The design and testing of various sound-reinforcement systems for the International Hotel, Las Vegas, Nevada
Robert E. Reim, Hannon Engineering, Inc., Los Angeles, California

O4 Providing foldback with out-of-phase loudspeakers
Edward S. Jones, Brigham Young University, Provo, Utah

O5 Multichannel sound systems for multipurpose halls
Lewis S. Goodfriend, Goodfriend-Ostergaard Associates, Subsidiary of Zurn Industries, Inc.

O6 The big sound is on the move with Disney on Parade
Albert A. Huff, Hannon Engineering, Inc., Los Angeles, California, and William E. Blanton, Disney on Parade, Anaheim, California

O7 Sound systems in reverberant rooms for worship
David L. Klepper, Bolt, Beranek and Newman, Downer's Grove, Illinois

Thursday, May 7:
(7:30 p.m.)

AUDIO APPLIED TO EDUCATION, SCIENCE, AND INDUSTRY

Chairman: Norman L. Chalfin, Jet Propulsion Laboratory, Pasadena, California

P1 Acoustical holography and its potential as a tool for studying sound fields
Dr. Alexander F. Metherell, Douglas Advanced Research Laboratories, McDonnell Douglas Corp., Huntington Beach, California

P2 Audio communications for the scientist
Claren L. Oakley, Audio-Digest Foundation, Glendale, California

P3 Digital-audio industrial-control devices
Clarence Hemphill, Aeronautical Dept., California Institute of Technology, Pasadena, California

P4 Multimedia audio-visual techniques and related sound-signal actuation techniques
Martin R. Klitten, The Klitten Company, Inc., Pacific Palisades, California

P5 Transient response of earphones for auditory research
J. E. Jenkins-Lee, Department of Surgery, Stanford University School of Medicine, Stanford, California

Thursday, May 7:
(6:30 p.m.)

Bus pick-up for AES registrants with reservations only at 7th street entrance of hotel on lower lobby

(7:00 p.m.)

Various recording studios in the Hollywood/Los Angeles area

A RECORDING STUDIO WORKSHOP

Chairman: WILLIAM L. ROBINSON, Sunset Sound Recorders, Hollywood, California
Co-Chairman: ANDREW BERLINER, Crystal Industries, Inc., Hollywood, California

Co-Chairman: J. JERROLD FERREE, United Recording Corp., Hollywood, California

Q A recording studio worshop
William L. Robinson, Andrew Berliner, J. Jerrold Ferree, and others to be announced later

Equipment Profiles

Epicure Model 100 Speaker System

MANUFACTURER'S SPECIFICATIONS:

Usable response: 30-18,000 Hz. **Omni-directional response:** 40-13,000 Hz ± 3 dB **Minimum Amplifier Power Required:** 18 Watts rms. **Recommended Maximum Power:** 60 Watts rms. **Impedance:** 8 ohms. **Harmonic Distortion:** Less than 5% at all frequencies. **Cabinet Size:** 21" x 11" x 9". **Price:** $89.00.

EPI is a new name to add to the list of speaker manufacturers. And the Model 100 certainly is a fine opening number. It is the smallest and least expensive of four available systems, each of which utilizes identical components but in varying quantities. The Model 100 consists of one woofer/tweeter module. The Model 201 has two, the Model 500 has four, as has the "Tower" Model 1000, but one on each surface.

Having found the right "combination" to the acoustic balance problem, Epicure's modular approach is economical and logical. If the performance of the Model 100 is representative of the others, as it probably is, then we can look forward to a popular new line of speakers.

The Model 100 system is small, light, and truly of bookshelf dimensions. It weighs under 20 pounds. It puts out surprisingly big sound, is a little more efficient than units of similar size, and ranks high on our list of bookshelf systems. Each speaker comes with its own frequency-response chart and a 10-year guarantee which includes shipping.

One of the engaging features of the system is its simplicity, which includes two design features. One is the acoustic-suspension tweeter and the other is the capacitive crossover network. The tweeter is 1" in diameter, which is small and therefore capable of very wide high-frequency dispersion. In order to produce appreciable power at high frequencies, rather than make a larger and more directional tweeter, EPI has allowed for large tweeter excursions, using a miniature acoustic-suspension design for the tweeter. The top of the magnet structure is hollowed out to form a small cavity against which the cone works on a 1/4" air cushion. The voice coil and tweeter cone are rigidly interlocked and supported with a rubber-impregnated-cloth surround, the purpose of which is to damp out resonances while allowing freedom of motion.

An 8" high-compliance woofer with a 16-gram voice coil 3/4" long in a 1/4" magnetic gap covers the frequency range below 1800 Hz. The woofer has a free air resonance of 18 Hz and in its acoustic suspension enclosure, produces sound down to 40 Hz. The long voice coil and 200% overhang allows a large 1/2" excursion.

The crossover network which electrically separates the drivers from each other and from the power amplifier, is not present in this unit. What is used here is simply an 8-μF 50-volt capacitor in series with the tweeter. Epicure feels that this is an effective and economical solution, eliminating phase shift problems caused by complex inductive and capacitive networks traditionally used. The woofer is apparently insensitive to high frequencies which are fed to it and in combination with this simple cross-over system provides the 18-dB/octave attenuation.

Both speakers and capacitor are mounted from the rear of the front panel. The front panels of our test samples worked themselves loose and had to be glued back. The cabinet is stuffed with fiberglass. Speaker terminals are recessed at the rear. No controls or attenuators are provided to alter the tweeter/woofer balance. The cabinet comes finished on four sides in oiled walnut with light beige grille cloth in front.

Our frequency-response tests, using ⅓-octave-band pink noise, pretty well confirmed the manufacturer's data, although we could not duplicate the frequency-response curve supplied with the units, as the curve was doubtless plotted in anechoic test conditions. The manufacturer's curve is shown in Fig. 1. We did obtain a smooth response of 55 to 15,000 Hz nevertheless, with exceptionally fine dispersion and excellent transient response, as shown in Fig. 3. Dispersion remained excellent up to 11 kHz at which point the higher frequencies became more directional and rolled off from 15 kHz. The bass rolled off sharply below 45 Hz and a small amount of doubling became evident at 70 Hz but this did not increase significantly at the lower frequencies. The impedance curve is shown in Fig. 2.

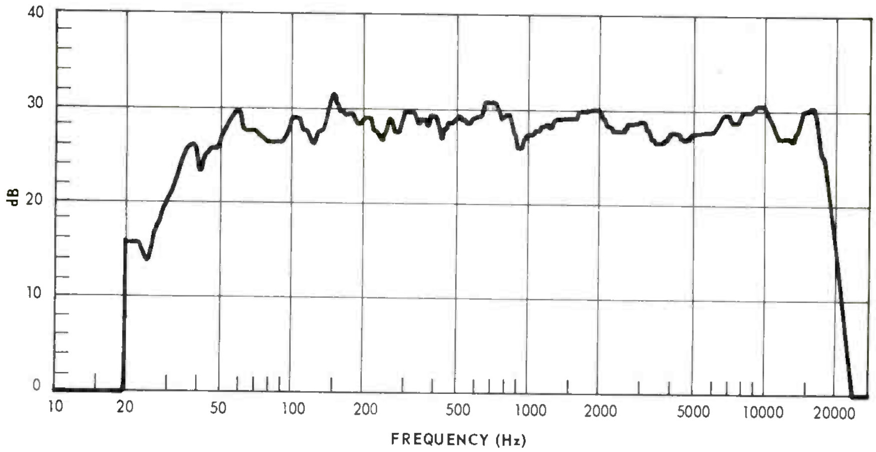


Fig. 1—Frequency response curve (supplied by the manufacturer).

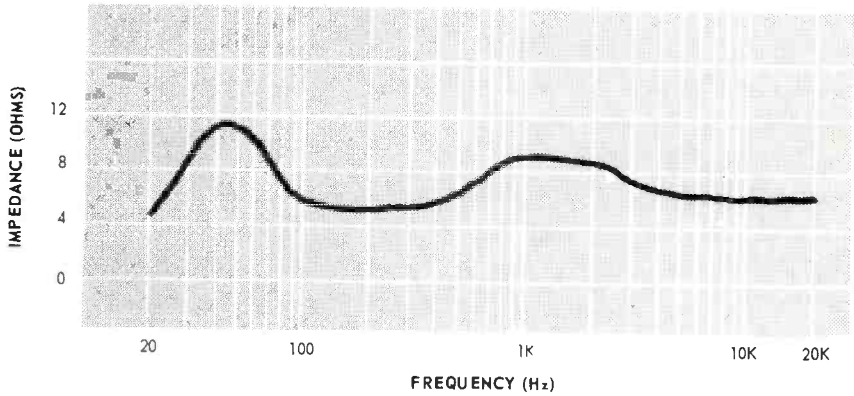


Fig. 2—Impedance curve.

Listening tests confirmed the transient-response capability, making percussion sounds come alive and practically omnidirectional. We found we could play the thing louder than one would think possible from its size. The sound was uncolored and open, and the stereo image remained solid at all times. The bass lacked the very bottom which is the fundamental on certain musical items, but on most material, that didn't matter. We were impressed with the quality of sound it produced when fed from a good program source.

In order to have adequate reserve power for good transient response of reasonable listening levels, we recommend as a minimum, a 30-watt-rms-per-channel amplifier to drive the speaker system properly. A. R.

Check No. 47 on Reader Service Card

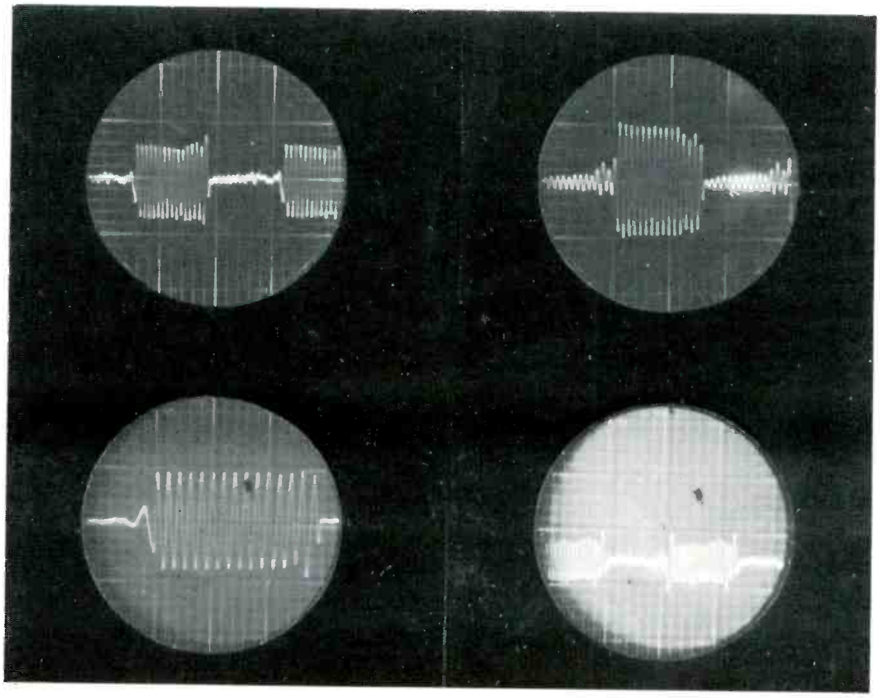


Fig. 3—Tone burst response at (a) 1500 Hz, (b) 1800 Hz, (c) 5000 Hz, (d) 10,000 Hz.

Fig. 4—Showing bass speaker used in the EPI-100. Note the large double magnet.

The AR FM Receiver

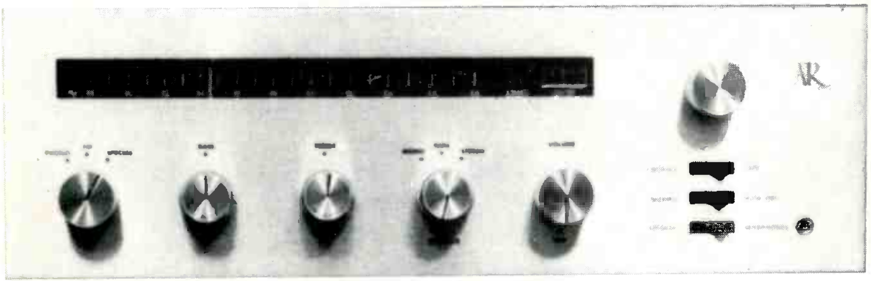


Fig. 1

MANUFACTURER'S SPECIFICATIONS:

FM SECTION: IHF Sensitivity: 2.0 μV or better. **S/N:** 65 dB. **THD:** Less than 0.5%, mono or stereo. **IM:** Less than 0.5%, mono or stereo. **Drift:** 50 kHz maximum. **Frequency Response:** 20 Hz to 15 kHz, ±1 dB. **Capture Ratio:** 2.0 dB or less. **Selectivity:** 55 dB or more. **Image Rejection:** 70 dB or better. **IF Rejection:** 100 dB or better. **Spurious Response Rejection:** 90 dB or better. **Stereo FM Separation:** 40 db @ 400 Hz; 35 dB @ 50 Hz.; 30 dB @ 10 kHz.

AMPLIFIER SECTION: RMS Power Output (per channel, both channels driven): 60 Watts @ 4 ohms; 50 Watts @ 8 ohms; 30 Watts @ 16 ohms. THD: less than 0.5% from 20 Hz to 20 kHz at all power levels up to rated power. IM **Distortion:** Less than 0.25% up to and including full power output. **Frequency Response:** ±1 dB from 20 Hz to 20 kHz at indicated flat tone control settings. **S/N:** Phono: 57 dB, ASA "C" weighting: **High Level Inputs:** 75 dB, "C" weighting. **Input Sensitivity:** Phono: 2 to 5 mV (adjustable) for full power output; **High Level Inputs:** 200 mV for full power output. **Damping Factor:** 8 to 20 @ 4 ohms; 16 to 40 @ 8 ohms; 32 to 80. (Lower figures at 20 Hz, higher figures from 75 Hz to 20 kHz.)

GENERAL: Dimensions: (Less wood cover) $16\frac{5}{8}$ in. W. $5\frac{11}{16}$ in. H x $11\frac{1}{8}$ in. D.; With wood cover: $17\frac{1}{4}$ in. W. x 6 in. H. x $11\frac{1}{8}$ in. D. **Suggested Retail Price:** $420.00 with black aluminum cover. Optional oiled walnut cover: $20.00.

With the introduction last year of the Model "A" integrated amplifier (Reviewed in AUDIO, Nov. 1969), Acoustic Research Inc. seems to have established a design philosophy which it has carried over into its new entry, a complete FM Stereo Receiver. The format seems to be to provide a basic, honest design which meets or exceeds all its specifications and leave out *all* "unnecessary" frills, gimmicks, seldom used controls, and soon. There will be those who will differ with this approach, but there will also be others who will appreciate the uncluttered, almost austere front panel of this receiver, shown in Fig. 1. A long, narrow but well illuminated dial scale, including the usual stereo indicator light and a center-of-channel tuning meter plus a good-sized tuning knob occupy the upper half of the flat, gold anodized aluminum front panel. The dial scale is absolutely linear (every MHz is equidistant from its "neighbor," while the tuning knob is coupled to a weighted flywheel which provides what has to be the smoothest tuning action we can ever recall having tested! The lower half of the panel contains a three position selector switch (Phono, FM, and "Special," or high-level inputs), dual-concentric clutch-type bass and treble controls for individual tone control adjustment of left and right channels, a mode switch concentrically mounted with a balance control, and a master volume control which also serves as the power on-off switch in its most counterclockwise position. In addition, there are three "rocker" type switches which provide tape monitoring (or, tape playback input directly to the main amplifier section), muting on and off, and speakers vs. headphone selection. The lower right corner of the panel is equipped with a stereo headphone jack. That's all there is on the front panel. It is obvious that the engineers at AR felt that they preferred to provide outstanding performance at a price of $420.00 and elected to omit features offered by competitors, either because they felt they were not needed or because it would have boosted the selling price above desired target.

There is one feature found on the AR receiver control panel which is both novel and useful. The mode switch, in addition to having settings for mono and stereo operation, has a position called "null," which is used to balance aurally the two electrical output signals more accurately than can be done by "standing mid-way between the two loudspeakers." We first saw this circuit in early stereo amplifiers of the late nineteen-fifties and thought it was a good idea then. While other manufacturers never chose to incorporate it, AR has made it a feature of both their integrated amplifier and this particular receiver design. Here's how it works. When the mode switch is set in the NULL position, one input channel is reversed in phase, with unity amplification. It is then combined with the other channel and the combination is fed to both receiver outputs. If the input signals are identical except for amplitude, a sharp reduction in loudness is obtained through cancellation when the balance control is correctly adjusted. Obviously, a monophonic source of program material must be used in order for this circuit to work properly and the NULL circuit cannot compensate for two speakers of different efficiencies, but in our tests, it proved to be quite effective in establishing correct electrical balance, particularly when we fed tape-recorded material to the receiver, in which the two recorded channels were originally recorded at somewhat different levels.

A view of the rear panel of the AR Receiver is shown in Fig. 2. Speaker fuses, FM antenna strip, left- and right-

Fig. 2—Rear panel view

speaker terminal strips are located at the left, while inputs and outputs for tape, the adjustable phono input level control and a chassis ground terminal are located at the right. All input and output connections are color coded, which is useful only if you happen to own AR turntable equipment and AR-supplied speaker cables. While spacing between "hot" and

The independent test labs think as highly of the Dual 1219 as we do.

No surprise. Because with every Dual tested, every performance claim we've ever made has been confirmed by independent test labs. With no exceptions.

Four years ago, for example, we introduced our 1019. Audio experts rated it the finest automatic turntable ever made. But we were already hard at work on what was to become the Dual 1219.

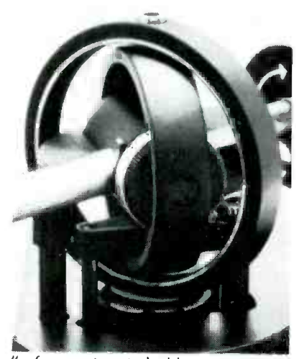
"anti-skating . . . reduced wear on the record grooves . . ." Audio

Is it the worthy successor to the 1019 we believed it would be? Stereo Review says it is.

"The 1219 is a good illustration of how an already superior product (the 1019) can be further improved by intelligent and imaginative design and engineering."

High Fidelity also agreed, with such specifics on the 1219's performance as these:

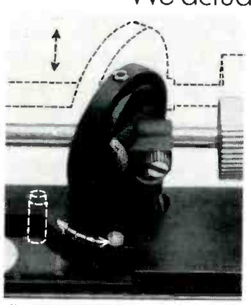
"Speed accuracy is greater (than the 1019), wow and flutter are a bit lower, tracking force and anti-skating adjustments are more precise...outstanding in all these characteristics."


"...four point gimbal-bearing system of extremely low friction." American Record Guide

As for the benefits of the 1219's gimbal-suspended 8-3/4" tonearm, The American Record Guide's results showed:

"The arm carries the cartridge in a way that permits it to extract every subtlety it possibly could from the record groove."

We actually felt the 1219 might have more precision than most people would ever need. But Audio disagreed, we're pleased to note:


"...novel adjustment for optimizing vertical tracking angle..." High Fidelity

"Whether or not the advantages of exact setting for vertical tracking and for anti-skating can be identified by the average listener, measurements show that there are improvements...reduction in distortion, and...reduced wear on the record grooves, particularly on the side of the groove nearest the center of the record."

Complete reprints of these test reports are yours for the asking. So is a 16-page booklet which reprints an informative Stereo Review article on turntables and tonearms.


"...will have greatest appeal to those who dislike any compromise..." Stereo Review

After you look through all of this, you'll understand why most hi-fi experts have Duals in their own systems. And why every record you buy is one more reason to own the $175 Dual 1219.

United Audio Products, Inc., 120 So. Columbus Ave., Mt. Vernon, New York 10553. Dual

Check No. 49 on Reader Service Card

ground speaker terminals is adequate, the type of terminal used is the simple "wire wrapped under the screw" type, which has led most other manufacturers to use barrier terminal strips or other "short-proof" types even if their output circuitry is protected against "dead shorts," as is the case with this receiver. A power line fuse and two convenience a.c. receptacles (one switched, the other unswitched) complete the rear-panel layout. The black aluminum cover supplied as standard equipment on the AR Receiver (the walnut cover is a three-sided affair that fits *over* the existing metal enclosure) is a one-piece weldment which, when re-

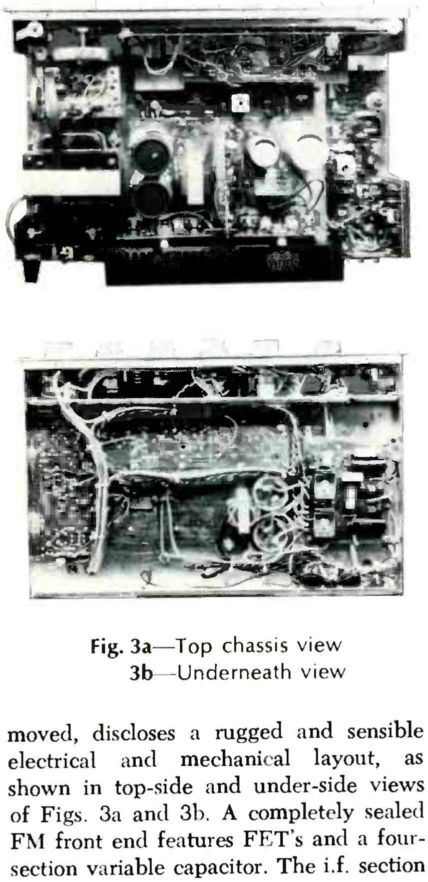


Fig. 3a—Top chassis view
3b—Underneath view

moved, discloses a rugged and sensible electrical and mechanical layout, as shown in top-side and under-side views of Figs. 3a and 3b. A completely sealed FM front end features FET's and a four-section variable capacitor. The i.f. section features integrated circuits and a multi-section crystal filter. Special audio circuits include a d.c. driver-clamping circuit to provide clean clipping and recovery from overloads. With power switch OFF, a special idler supply takes over to eliminate turn-on pulses and "pops." Besides the speaker fuses mentioned earlier, each channel is equipped with a self-resetting thermostatic circuit breaker. A total of seven printed-circuit modules are used in the receiver, and output devices are mounted on massive finned heat sinks which were only comfortably "warm to the touch" after hours of our laboratory testing with low-, medium-, and high-power outputs. The driver stage is a little unusual in that it uses push-pull drivers with a transformer. Figure 4 shows the basic circuit. C1 prevents d.c. being applied to the transformer primary and R1, C2 form a high-frequency "step" circuit. The main feedback loop is applied via R2, C3 from the speaker output back to the emitter of the first transistor.

Electrical Measurements

Important FM characteristics measured with respect to the AR Receiver are shown in Fig. 5. IHF sensitivity was exactly 2 μV, as claimed and full limiting (1 dB) took place at a very low 1.75 μV. Ultimate signal-to-noise ratio, reached at a signal input level of about 20 μV, was 65 dB, conforming nicely to published "specs" once more. THD in mono (and, more significantly, in stereo) was 0.5%. Stereo separation, shown in Fig. 6, exceeded 40 dB (and the limits of our test equipment) at mid-band, and maintained a level of at least 30 dB all the way from 50 Hz to 10 kHz—about the best we have ever measured. The muting control (which AR chooses to call a "hush" control) was overcome by signals having an amplitude of between 5 and 7 μV, but since listenable signals of as low as 3 and 4 μV were received in our listening tests, the mute defeat switch is a necessary front-panel control for those wishing to listen to such "fringe" signals. The mute threshhold is not adjustable by the customer. The extremely linear FM detector response is shown in the 'scope photo of Fig. 7.

Because of the excellent performance of the amplifier section of this receiver, we decided to plot THD for a single channel with both channels driven as well as with only one. The results are shown in Fig. 8. With both channels driven, THD reached rated 0.5% at 53.8 watts, well above published claims. With only a single channel driven, power output attained was 57.6 watts for the same 0.5% distortion. The similarity between these two power-output extremes indicates that the power supply is very well regulated. IM distortion, also plotted in Fig. 8 (for both channels driven) reached 0.25% at an output power of 51 watts. More importantly, neither IM or THD exhibited any rising characteristic at lower power outputs—a failing common with some solid-state designs. Readers may note the absence of the usual Power Bandwidth curve in this report. Its absence is a credit to the AR receiver for, quite honestly, our equipment only goes down to 10 Hz and up to 40 kHz, and at these frequencies, the AR receiver was not only able to supply "half power" as defined in Power Bandwidth Measurements, but just about *full rated power* at under 0.5% THD. We have to presume, therefore, that the actual power bandwidth (not stated by AR) actually extends below 10 Hz and above 40 kHz, making the actual end figures rather academic!

Tone-control range is plotted in Fig. 9 and is seen to be completely symmetrical about the zero axis at both high and low ends. Frequency response was flat within 0.5 dB from 10 Hz to 30 kHz with tone controls set to mechanical center, while channel balance within 3 dB was maintained at all settings of the master volume control down to 65 dB below maximum.

Listening Tests

The AR Receiver demonstrates its more-than-adequate reserve power at all dynamic levels, when auditioned with our low-efficiency speaker systems. Transparency of sound and good transient response were in evidence throughout our listening tests—so much so that we regretted the lack of multiple switching facilities for a second pair of speakers which this receiver could easily drive. Of course, a second set of speakers can be added with external speaker switching facilities, if desired, but this is one nicety that we feel could have been incorporated without destroying the "simplistic" approach inherent in the AR's external design philosophy. A third-channel output is provided, by the way, but it is for use with an additional power amplifier, not for direct use with a third, center-channel speaker.

In our FM listening, with indoor dipole, we managed to pick up 43 usable signals with the "hush control" turned off. With this control actuated, the number was reduced to 36, indicating that at least 7 stations had been previously received at signal levels of 7 μV or less and were still very listenable. Transferring antenna terminals to our out-door directional Yagi array, the number of stations received increased to 54, with no attempt made to rotate the antenna for even more stations which would undoubtedly have been satisfactorily received. Calibration was just about *perfect*, despite the expanded and linear scale.

Summary

The Acoustic Research FM Receiver offers more than its $420.00 worth of honest performance and it will appeal to those who favor high distortion-free power with a minimum of controls. *LF*

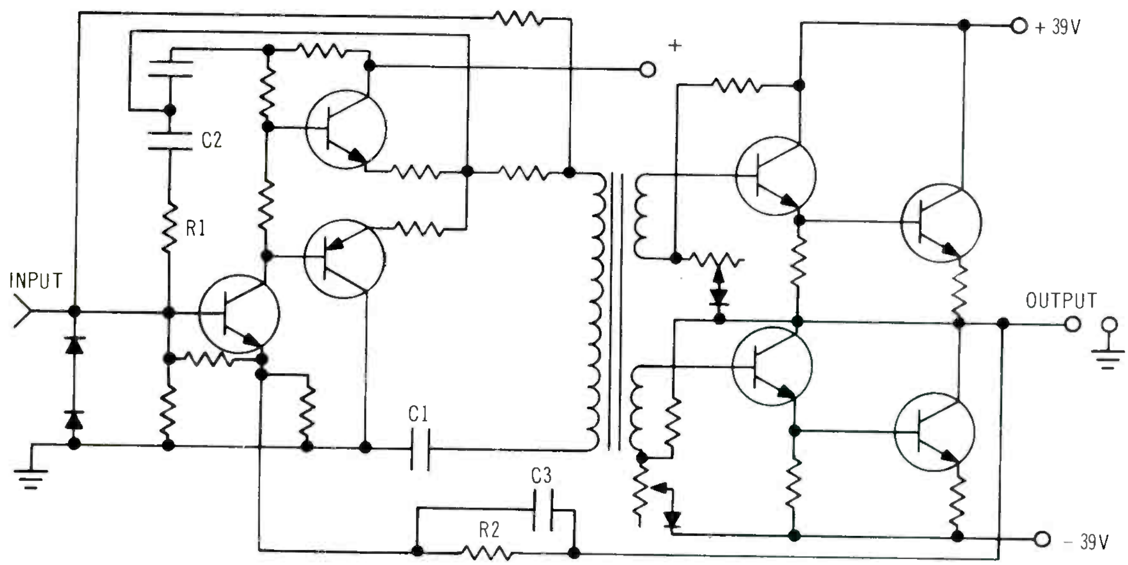


Fig. 4—Basic circuit of driver and output stages

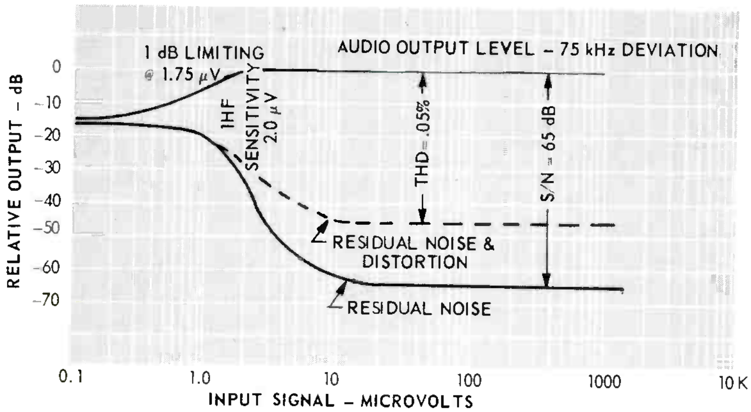


Fig. 5—FM characteristics

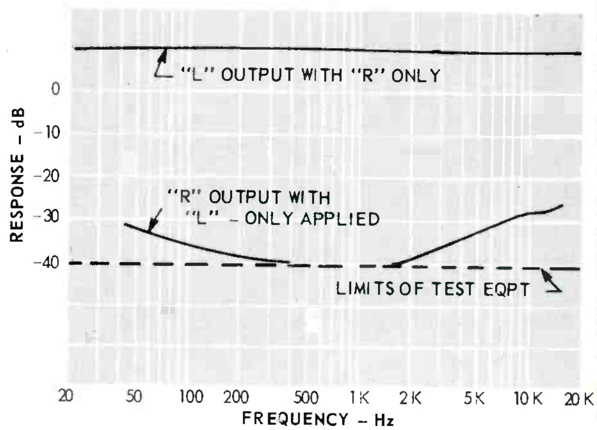


Fig. 6—Stereo separation

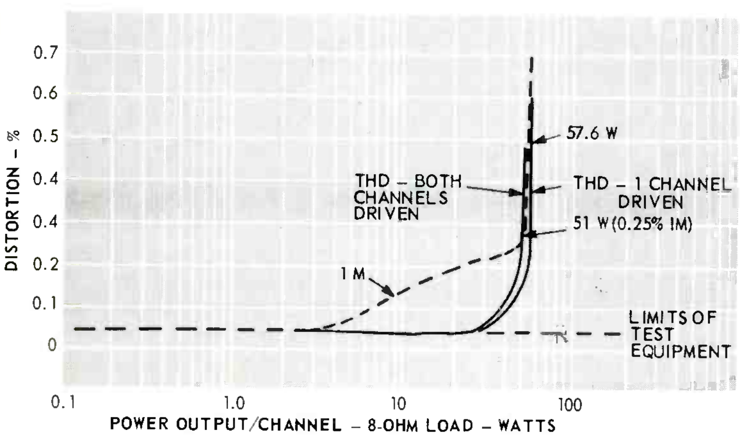


Fig. 7—THD and IM characteristics

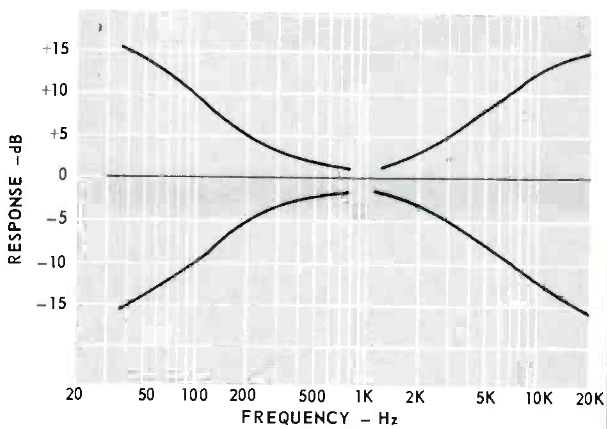


Fig. 8—Tone control curves

Harman-Kardon Citation Twelve Basic Power Amplifier

Fig. 1

MANUFACTURER'S SPECIFICATIONS:

Continuous Power Output: 120 W, both channels driven simultaneously. **THD:** Less than 0.2%, 20-20,000 Hz, into 8-ohm load. **IM:** Less than 0.15% at all power levels, 60 and 6000 Hz, 4:1. **Hum and Noise:** Better than 100 dB below 60 W. **Frequency Response:** 1 Hz to 70 kHz, ±1 dB at normal listening level; 0.5 Hz to 100 kHz ±1 dB. **Power Bandwidth:** 5 Hz to 35 kHz; **Dimensions:** 5 7/16" H x 12 15/16" W x 12 5/8" D (complete with metal cage). **Weight:** 30 lbs. **Price:** $295 wired; $225.00 in kit form.

Harman-Kardon has done it again. That is to say, they have brought out another Citation. After a long absence from the marketplace, Citation Twelve is the first of a new generation of solid-state equipment, and it lives up to the reputation made by the earlier Citations.

Listed as *an* amplifier, the Citation Twelve is actually two separate amplifiers on the same chassis, which they share. There are two power transformers, two separate silicon bridge rectifiers, and separate filter systems. Both transformers are wound with split primaries which are normally connected in parallel for 117-volt operation, but which may be rewired in series for use on 220-240-volt lines. The primary circuits are protected by a line fuse, and by a thermal circuit breaker which is in contact with one of the output transistor cases and which opens the primary circuit if the transistor case should get hotter than 80°C.

In addition to sharing the chassis, the two amplifiers share a printed-circuit board on which the stages prior to the output transistors are mounted, but at no place are they interconnected. In fact, the only place where the two amplifiers are connected together is at the ground, and even there the right channel is isolated from chassis ground by a 10-ohm resistor to avoid hum loops. The printed-circuit board is fitted with twenty-eight Molex connector sockets which mate with pins mounted in five nylon connector blocks installed in the chassis openings. The two amplifier circuits are essentially mirror images of each other, so the printed-circuit board could be inserted either way with no effect on performance. The board is held down by two nylon "A" frames, which may be removed if the circuit board is to be unplugged for service reasons.

The four output transistors—two per channel—are mounted on four heavy-duty heat sinks which serve as the front of the unit, with the dress panel with input and output connections, the power-line fuse posts, and the pilot light. The power cord enters from the rear chassis apron. Figure 2 shows the amplifier with the cover removed, while Fig. 3 shows the underside. Note the separate ground buses—one for each channel—running from the rear of the chassis forward and towards the sides where they provide ground connections for the input jacks. The physical connection between the ground buses and the chassis are taken from the center of the bus running between the filter capacitors so as to be at the exact electrical center of each of the circuits to minimize hum.

The Circuit

Electrically, the circuit of the Citation Twelve is similar to an operational amplifier, and it is likely that this configuration will be seen in more and more amplifiers in the future. It employs a balanced-to-ground circuit, with positive and negative supply voltages, so that the output lead is at ground potential, thus eliminating the need for series output capacitors. The only capacitor in the signal circuit is at the input, which accounts for the exceptional low-frequency performance of the amplifier. The input signal is fed to one base of a differential transistor —a dual PNP type—and feedback is routed to the other base, resulting in a comparator circuit which balances automatically for zero d.c. offset voltage at the output terminals. The signal from the differential amplifier is fed to a pre-driver, which feeds the PNP driver directly and the NPN driver through a bias network which has its heat-sensing double-diode mounted on one of the heat sinks. Two test points are provided on each half of the circuit board to permit setting of idling current through the output transistors to a mere 30 mA. A potentiometer is mounted on the board for each channel to permit this adjustment. The complete schematic of one channel is shown in Fig. 7.

The output transistors are mounted on four separate heat sinks of husky dimensions. Each is 3 1/8 in. square, with nine 1 1/4-in. fins on one side of the 1/4-in. base plate, from which another 1/4-in. section projects 1 3/8 in. from the side opposite the fins. It is this projection on which the output transistors are mounted, along with the double diodes on two of the heat sinks, and with the line circuit breakers on the backs of the transistors on the other two sinks.

Construction

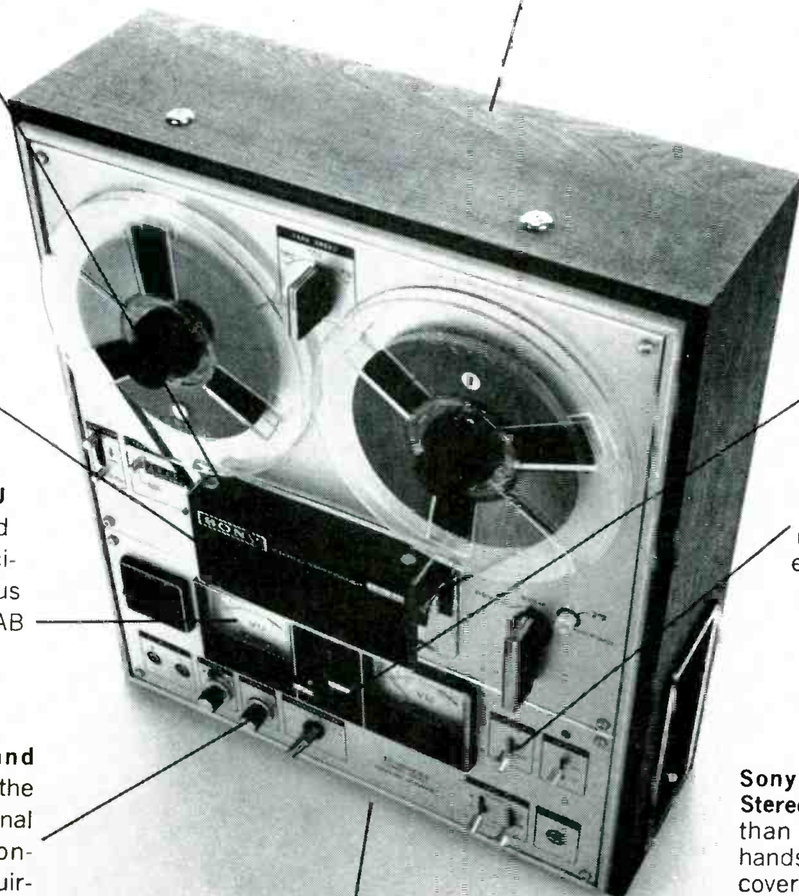
This observer had the opportunity to construct a Citation Twelve from a kit of parts, and had no difficulty at all. The Molex connector blocks snap into holes in the chassis. The constructor mounts the transformers and the filter capacitors, as well as the front-panel hardware. The circuit board involves the mounting of 34 resistors, 14 capacitors, 2 potentiometers, 2 r.f. chokes, 2 diodes, and 10 transistors, all of which can be done easily in less than two hours. Chassis assembly and wiring should not take more than eight hours, assuming some familiarity with construction, so for ten hours of work you can save $70.00 if you are so inclined. Best of all, however, is that you will have an excellent product of which you can

Music lovers, take control!

Specs You Can Brag About. Frequency response: 20-22,000 Hz @ 7½ ips, 20-17,000 Hz @ 3¾, 20-10,000 Hz @ 1⅞. Wow and flutter: 0.09%. Signal-to-noise ratio: 52 db.

Three Heads. Allows monitoring of either input source or the actual recording made on the tape.

Non-Magnetizing Record Head. Head magnetization build-up, the most common cause of tape hiss, is eliminated by an exclusive Sony circuit which prevents any transient bias surge to the record head.



Professional Slide Controls. Two finger-tip controls are positioned vertically side by side for immediate precision adjustment of recording volume. Easier to read, easier to establish interchannel volume relationship than with conventional knobs.

Full-Size Professional VU Meters. These internally lighted instruments provide the precision metering for really serious recording. Calibrated to NAB standards.

Noise-Suppressor Switch. Special filter eliminates undesirable hiss that may exist on pre-recorded tapes.

Built-in Sound-on-Sound and Echo. Switching networks on the front panel facilitate professional echo and multiple sound-on-sound recordings without requiring external patch cords and mixer.

More Sony Excellence. Ultra-high-frequency bias. (Sony achieves lowest recording distortion through use of ultra-high bias frequency—160 KHz!) Scrape flutter filter eliminates tape modulation distortion. Automatic shut-off. Pause control with lock. Vibration-free motor. Four-digit tape counter. Automatic tape lifters for fast-forward and rewind reduce head wear. Retractomatic pinch roller for easy tape threading. Variety of inputs and outputs. Vertical or horizontal operation.

Sony Model 630-D Solid-State Stereo Tape Deck. Buy it for less than $299.50, complete with handsome walnut base and dust cover. **Also available:** The Sony Model 630 Solid-State Three-Head Professional Stereo Tape System, with stereo control center, stereo power amplifiers, microphones, and lid-integrated full-range stereo extension speakers, for less than $449.50. For a free copy of our latest catalog, please write Mr. Phillips, Sony/Superscope, 8142 Vineland Avenue, Sun Valley, California 91352.

SONY SUPERSCOPE The Tapeway to Stereo

You never heard it so good.

be proud, and you will have joined the elite of kit builders—those who have built Citations.

Performance

In practically every category, the Citation Twelve surpassed its specifications. We measured distortion at 60 watts at .06 per cent, and at 70 watts we found THD was only 0.15 per cent, while it reached 2.3 per cent at 80 watts for a short while—then the output circuit breaker cut out, as would be expected. Coming down the power scale, we found THD to be .06 per cent all the way down to a 1-watt output. We measured more distortion at 20 Hz, but there was more residual at this frequency. At 5000, 10,000, and 20,000 Hz, we also found distortion to remain at .06 per cent. We have heard of lower measurements on the Twelve, but those involve much more elaborate test equipment to get the residual down below the .04 per cent, which we find in our equipment. Intermodulation distortion measured 0.1 per cent at 60 watts and 0.2 at 1 watt. IM is normally higher at low levels than at rated output with solid-state amplifiers.

Crosstalk between channels was essentially unmeasureable, since it was greater than 100 dB at 1000 Hz, and was 76 dB at 10,000 Hz. Frequency response was within ±1 dB from 1 Hz to 100 kHz, which is as good as anyone could want for audio applications. Hum and noise was better than 100 dB below rated output when the input jack was shorted, and 86 dB below rated output with the input jack open. Power Bandwidth measured 4 to 35,000 Hz, slightly better than specifications, and is shown in Fig. 6.

With such exceptional low-frequency response, one would expect excellent square waves throughout the spectrum. From 20 to 10,000 Hz, there is little difference in the square-wave response, as shown in Fig. 5. The pattern at 20,000 Hz shows a rise time of approximately 2 μsec, which is exceptionally good.

The thermal cutout in the output line resembles a lantern flasher in appearance. If the output current exceeds a safe value for the transistors, these devices open the output circuit, thus protecting from direct shorts. As soon as they cool down, the circuit is restored to normal. During our tests we were measuring a loudspeaker at fairly high levels—exceeding the acceptable output of the amplifier, apparently. Consequently, we got a tone-burst effect from the speaker. The amplifier was not damaged in any way, and the measurements were made after this experience.

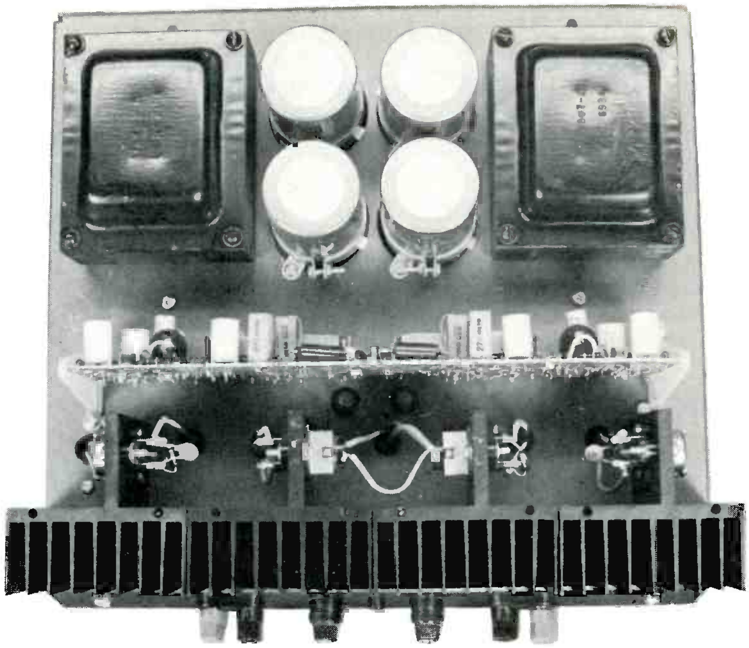


Fig. 2—View with cover removed

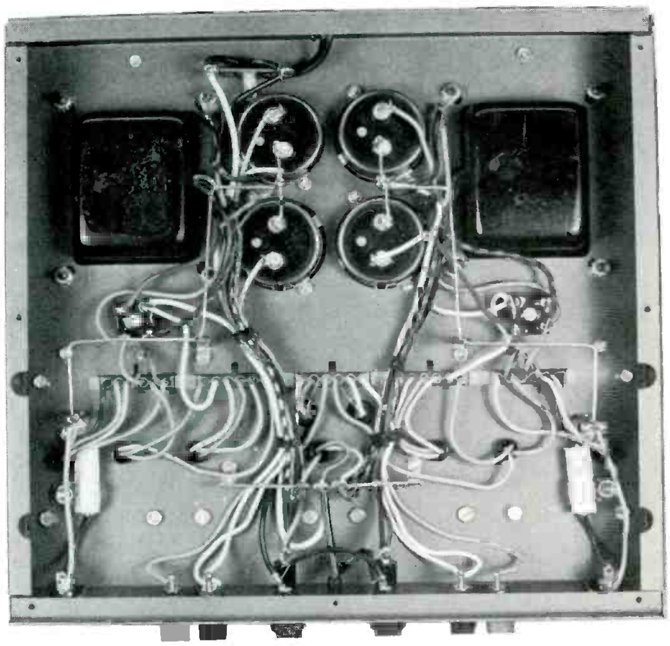


Fig. 3—Showing underneath. Note separate bus-bars.

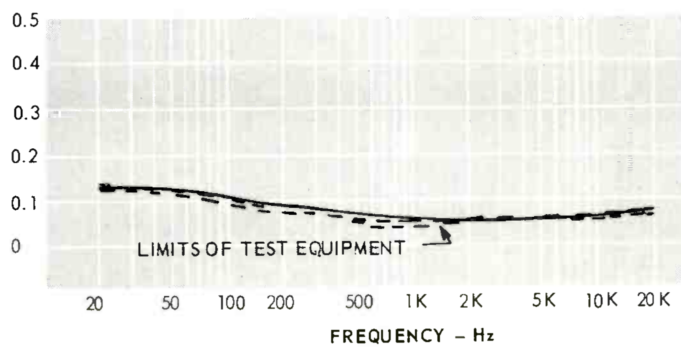


Fig. 4—Distortion vs Frequency

The manufacturer recommends placing a 1-amp fuse in the speaker line at the speaker—not at the amplifier—for 8-ohm loudspeakers rated at up to 60 watts *music power*, and 1.5 amp. fuses in the lines to speakers rated from 80 to 200 watts music power. For 4-ohm speakers, fuses of 1.5 and 2.0 amps are recommended rating. This is deemed necessary power rating. This is deemed necessary by the manufacturer because the Citation Twelve is capable of a continuous output of 60 watts per channel of *sine-wave power*, which could certainly exceed the *music power*, and 1.5-amp. fuses in the dition, this 60-watt power extends down to below 20 Hz, and the simple removal of an input plug could put a loudspeaker out of commission. In these days of high-powered solid-state amplifiers, this is a precaution that might well be taken by the user of any one of them, but it is particularly important when the amplifier can deliver power to the lower frequencies, There are no tubes to saturate nor are there any transformers which have reduced efficiency at very low frequencies and thus help to protect against large bursts of current to the speakers.

Listening to the Citation Twelve is an enjoyable experience. Reproduction is clean and crisp, with good, solid lows. You are just not conscious of the amplifier at all. As we said about the first Citation amplifiers, you listen *through* the amplifiers to the original source. And we say it even more so with the Citation Twelve.

C. G. McP.

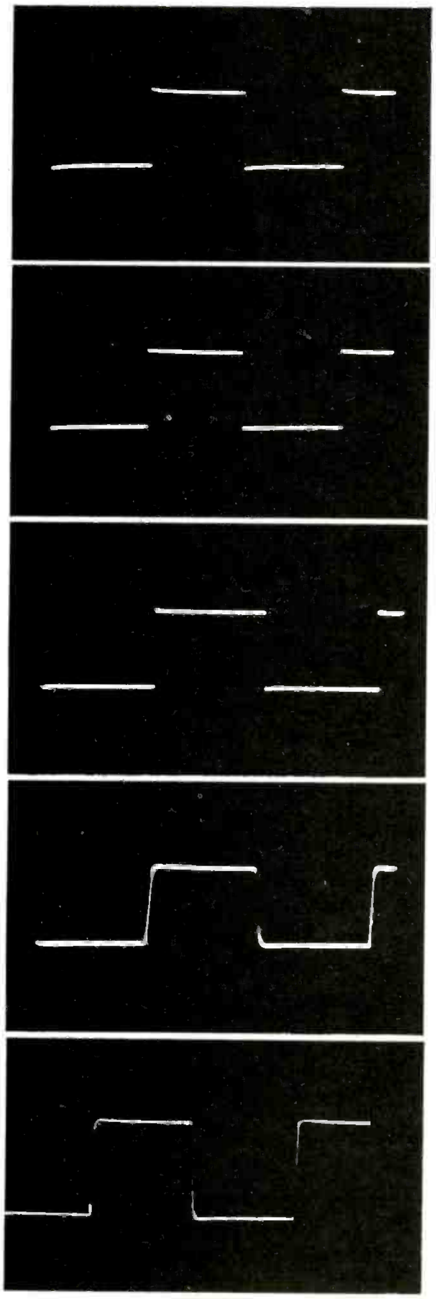


Fig. 5—Square-wave response. Reading from top, 20Hz, 100Hz, 1000Hz, 10,000Hz and 20,000Hz.

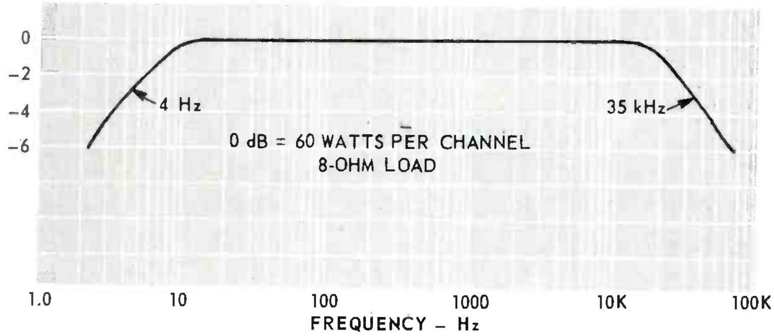
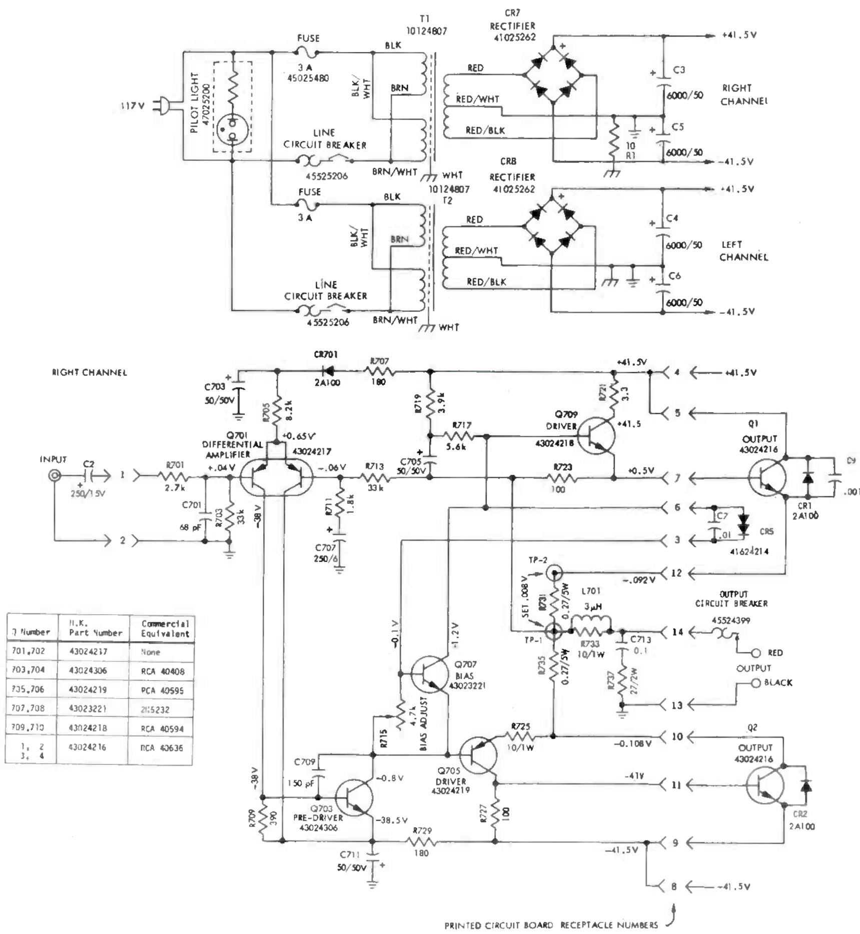


Fig. 6—Power Bandwidth curve



Q Number	H.K. Part Number	Commercial Equivalent
701,702	43024217	None
703,704	43024306	RCA 40408
705,706	43024219	RCA 40595
707,708	43023221	2N5232
709,710	43024218	RCA 40594
1, 2 3, 4	43024216	RCA 40636

Fig. 7—Schematic of one channel and dual power supply.

Advent Frequency Balance Control

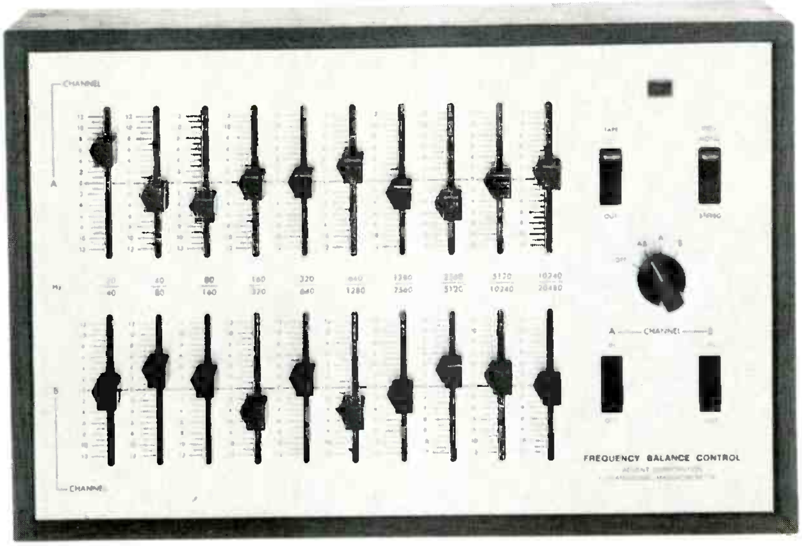


Fig. 1

MANUFACTURER'S SPECIFICATIONS:
Control Ranges: ±12 dB in each of 10 octave bands. **Channels:** Two, for stereo applications. **Switches:** Four rocker switches—tape in and out, mono or stereo input, and in/out for each channel. One rotary, with four positions—power off; AB, with both channels operating; A, with only the left (A) channel operating; and B, with only the right (B) channel operating. **Dimensions:** 12 x 7⅞ x 3¼ in. **Price:** $225.00.

The Advent Frequency Balance Control is a unique active equalizer that can alter tonal balance in your stereo system octave by octave, with each channel separately controllable. The ability of the user to control each octave independently permits the adjustment of the system to compensate for any deficiencies in the components themselves—and this includes the loudspeakers, as well as any other component. Furthermore, and this is probably more important, it permits compensation for the acoustic environment of the listening room. The Frequency Balance Control (FBC) is a *complete* tone-control system, but one which offers a flexibility not obtainable heretofore in consumer equipment. One exception to this was the monophonic Audio Baton which was on the market some years ago as a product of Blonder Tongue. Many of us remember this product, and they appear occasionally in our classified columns, both Wanted and For Sale.

The FBC consists of two separate channels of equalizers. Each channel is preceded by separate sections of the input-level switch which adjusts the gain of the unit to accommodate input signals in the three ranges of 0.5 to 1.0 V, 0.25 to 0.5 V, and less than 0.25 V. This switch and the phono jacks for external connections are shown in Fig. 2, along with the connecting instructions. The front panel is fitted with twenty slide controls, each covering one octave for one channel. The octaves are, respectively: 20-40, 40-80, 80-160, 160-320, 320-640, 640-1280, 1280-2560, 2560-5120, 5120-10240, and 10240-20480. The scale along each knob is marked in arbitrary figures from +12 to −12 in a linear fashion. The top row of sliders operates on channel A, and the bottom row operates on channel B, or the left and right channels as we more commonly refer to them. To the right of the two banks of slide controls are the pilot light at the top, the tape in/out and mono/stereo switches next, followed by the rotary switch, and it in turn followed by the two channel on/off switches.

Circuit

The FBC employs a total of 24 transistors—12 in each channel—and one IC. The input signal is fed to the level selector switch, and then to the base of an emitter follower which drives the ten equalized stages in parallel, as well as an unequalized terminating stage. Each of these stages has a collector-load resistor selected for proper gain for the stage, and each (except the last) is equalized by a pair of capacitors connected from the collector to ground, with the junction between them connected to the junction of two resistors in series which serve as the emitter resistor. The output of each stage is capacitively coupled to the arm of the slide control affecting that particular octave, and the "high" sides of the slide potentiometers are summed together and fed to an operational amplifier to provide sufficient output level. These outputs are then fed to a level-adjusting potentiometer accessible as a screwdriver adjustment, thence to the in/out rocker switch and then to the rotary switch. A transformer, bridge rectifier, and an effective filter circuit furnish the power.

The FBC is designed to be connected between the "recorder" output of your receiver or amplifier and the "tape monitor" input if available, or else to the "aux" input. With these connections made, you are ready to experiment with the unit, which will provide a wide variety of control, as shown by the following list:

1. Changing the balance of recordings you have found unsatisfactory for one reason or another.
2. Modifying the response characteristics of a cartridge to complement those of the loudspeaker.
3. Improving the overall musical balance of a speaker.
4. Correcting for some effects of room acoustics and furnishings.
5. Extending the frequency range of loudspeakers.
6. Improving the response characteristics of records, tapes, and broadcasts. These improvements can be made permanent if the material is recorded on a tape recorder.
7. Investigating (and changing, if you wish) the subtle response differences that exist between speakers. (It is literally possible

It's kind of a dumb-looking thing, but the ear is still the best listening device around. Which should tell you something about the shape of a Yamaha speaker.

True, the ear receives sound and a speaker reproduces it. But the basic principles of physics and design are essentially the same. There is a place in the middle through which the sound travels. Surrounding it are planes of varying dimensions. There is no symmetry.

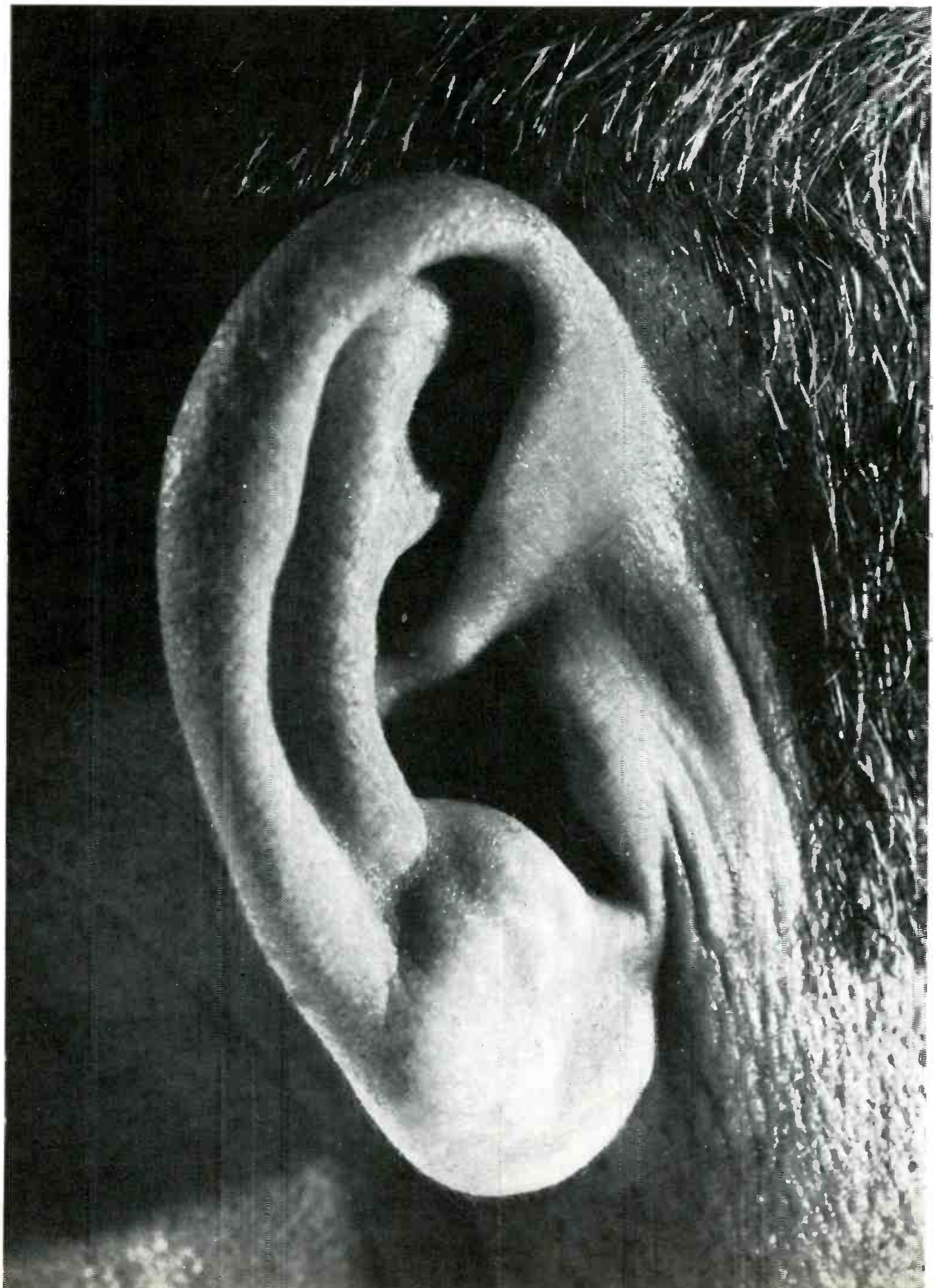
This is because sound is not symmetrical. It bends. So symmetrical shapes—ears or speakers—will confine sound to an area that won't let it bend naturally. (Cup your ear and see how directional and different things sound.)

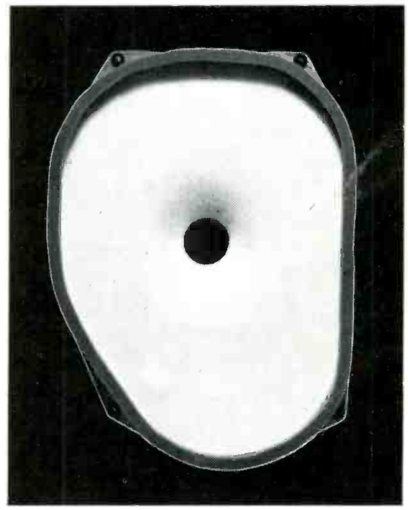
The irregular shape of a Yamaha speaker gives sound waves of different length a place to go. Long waves go to the long parts, medium waves to the medium parts and so on.

The result is a sound as close to natural as you've heard. Freer, fuller, more omnidirectional.

Listen to what natural sound is all about. If you're not convinced then, well, maybe you *are* wearing the wrong kind of ears.

Either we're right about the shape of our speakers, or you're wearing the wrong kind of ears.





YAMAHA

YAMAHA INTERNATIONAL CORP. Audio Products Division
7733 Telegraph Road, Montebello, Calif. 90640

to make the tonal balance of any good speaker sound very similar to that of any other good loudspeaker.

These recommendations are those which accompany the FBC, and offer the user a few ideas to start off with. We can think of a few more possibilities, such as these:

(a) Comparing an unknown speaker's response with that of a known model. Simply adjust the controls of the unknown speaker's channel until the two sound as nearly the same as possible. The control settings then show the comparative response.

(b) "Reprocessing" mono recordings to give a stereo effect, either in direct reproduction, or in re-recording. Set the controls of one channel for a 10-dB boost at a given frequency—say, 800 Hz, and set the other for a 10-dB droop at the same frequency. Proper choices of the points of equalization and the amounts thereof should result in a satisfactory stereo effect—or at least a pseudo-stereo effect—which could well help your old mono recordings.

Performance

The Frequency Balance Control *does* all the things that it is claimed to do. It does not have the enormous flexibility of a series of third-octave controls, but it is not likely that it would be used in the same applications as would the much-more-expensive third-octave equalizers. For the average intelligent consumer, however, the FBC is a great help in making his system do what he wants it to do. For a look at the frequency responses available from the various octave controls, study Fig. 2. Each of the curves is the result of moving one slider to the +12-dB indication on the scale. Then all the curves were plotted on the same graph. Imagine, if you can, the effect of putting some of the controls at an intermediate position and others at maximum, for example. Practically any desired "tone-control" effect desired can be obtained easily. Now, suppose you compare the "+" curves of Fig. 2 with the "−" curves of Fig. 3. Mix any desired combination of the plusses with any desired combination

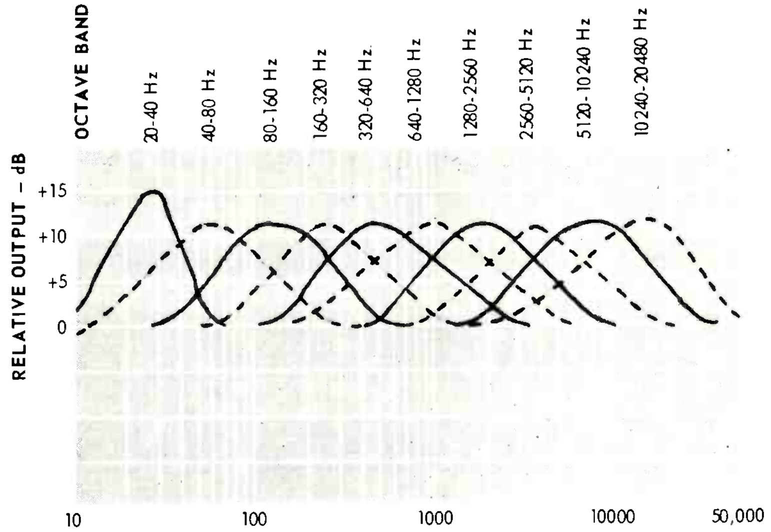


Fig. 2—Showing response with 12 dB increase.

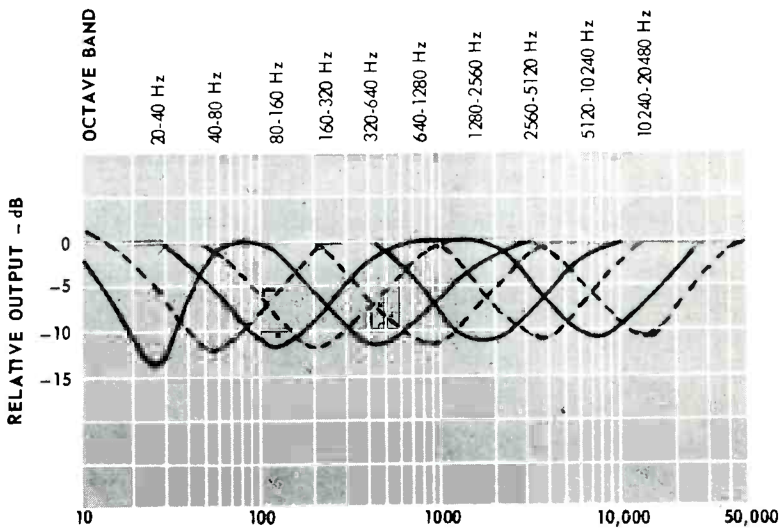


Fig. 3—As above, but with 12 dB decrease.

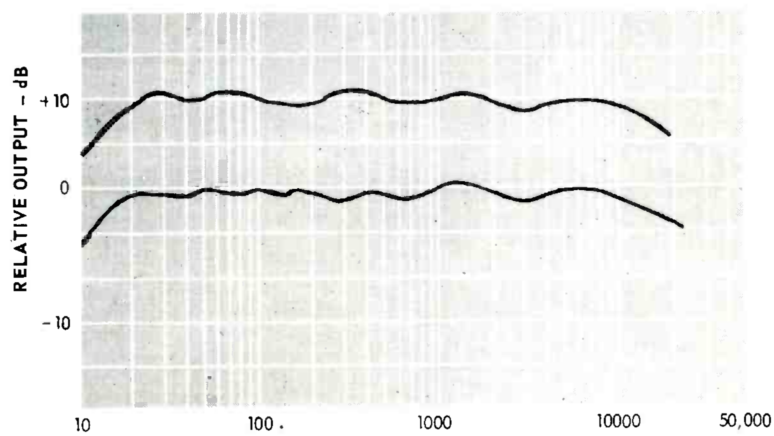


Fig. 4—Response in level position.

of the minuses and try to imagine what sort of responses you can obtain with all of this flexibility.

Suppose, however, you want flat response. Either throw the applicable switch to cut out the equalizer stages or else set all the sliders at the "0" on the scale. The measured response under this condition is shown at the lower curve in Fig. 4. Even if you move all the controls to the +8 position on the scale, you will get the response shown by the upper curve of Fig. 4. Similar effects are obtained with the minus positions of the sliders.

Figure 5 shows the actual dB of equalization of one control plotted against the scale indication of the slider position. It will be noted that there is somewhat more equalization than the scale indicates, but the scale is simply that, an indication. For the user's convenience, a pad of charts is furnished along with the FBC (and more can be obtained at a nominal price) so the user can indicate settings he found to be especially desirable for any given application.

One final question may come from readers of a more scientific or practical mind. "What is the distortion?" they will ask. With a device of this sort, you could make almost any distortion figure you might want, simply by setting the controls in a certain fashion. To give a fair answer, however, we measured the distortion with all controls set at "0" on the scale, and at a nominal output level—0.5 volts—we measured a THD of less than 0.5 per cent, at up to 1.0 volts of output. Signal-to-noise measurement was 60 dB with respect to 1.0 volt output in the LO sensitivity position, and IM was less than 0.5 per cent at the same output level. Had we set the control for the measuring frequency at maximum boost and all controls above that frequency at maximum cut, we would expect to get a much lower distortion figure, as we did—less than 0.25 per cent. Measurements on any frequency-varying device are difficult, and the Advent FBC is certainly a super "frequency-varying device." We commend it to all serious experimenters for its many technical uses; to all recordists for the effects they can obtain; and to all music listeners who may want to improve their environment of the performance of their equipment.

C. G. McP.

MUSIQUE CONCRETE

EDWARD TATNALL CANBY

The Very Beginning

An unusual historical recording has been released by Vox on its intermediate Candide label. The big, black letters say "Musique Concrete." The title is precisely accurate. This is a study of a kind of "far out" music that is already well into the past and significantly unlike today's much better known synthesizer music. *Musique concrete* is still being composed today but it is fast losing identity and the term itself has virtually departed—I hadn't heard it directly in years. Compared to "Moog" or "synthesizer," "musique concrete" is now positively esoteric. Yet this is where it all started.

Musique concrete is not only basically different in technique from today's synthesizings. Even its musical philosophy is quite different though, to be sure, the two approaches (and others) tend to interpenetrate according to local taste. *Musique concrete* was the original electronic music and it came out of France as the name suggests. It began even before tape, back in the late forties. Its earliest examples were painstakingly assembled via the old disk system, one record "dubbed" from another. *Musique concrete* is, very simply, the opposite of *abstract* music. Instead of the pure, abstract sounds of voices and instruments, it uses "concrete" sounds—that is, real, specific sounds with non-musical connotations, taken down and then doctored in the now familiar manner. Factory sounds, for example, as in Varese's landmark "Deserts," made in France in the early 1950s. Sounds of autos, pianos, bells, voices, knives and forks, a thousand and one very ordinary noises available everywhere and easily at hand. The weird sound structures made possible by manipulating these actual sounds into complex sonic club sandwiches were a new and fascinating experience in the 1950s and the resulting techniques were enough to keep whole schools of sonic structure-builders busy for years, and only an occasional howl from an oscillator suggested the synthetic future yet to come. Tape recording and editing, of course, provided the enormous boost the technique required. A godsend, after the hopeless bravery of disk manipulation! (I should know: around 1935 I laboriously created on dubbed *disk* a Bach chorale in which all four of the fuzzy, scratchy voices were my own. If I had only realized it, that was a pioneer experiment.)

For awhile *musique concrete* was a French exclusive but inevitably, in their special ways, others soon took over. Most notably the Germans, whose studious technical brilliance produced a much fancier and heavier school, now crowned by the works of such as Stockhausen. But the French had the imagination to start it all. As to our own early U.S. efforts, perhaps the briefly-used term "tapesichord music" will give an idea of their quality. The name is as *gauche* as were our first tries, including a 1955 spoof of my own (for a broadcast) in which I concocted a tape salad out of everything and the kitchen sink and called it the "Canby Concerto for This, That, and the Other." It was *musique concrete* carried to the absurd, for the time being at least. I forebore to try again but others carried on, including the well known Tod Dockstader (Owl Records) whose later works are the much-improved American climax of the school.

Vox's "Musique Concrete" is an apotheosis of the French branch of the art. Its material dates basically from the early sixties, all the works originating in the period just before 1963. (Since some are listed as "new versions" the record is later, but its spirit remains that of the earlier period.) Here is the original "concrete" technique in its ultimate French refinement. The first work on the record, indeed, is by that very Pierre Schaeffer, now 60, who in 1948 broadcast a "*concert de bruits*" ("Concert of noises") which must have been one of the earliest public attempts to formulate the new art. He established his Groupe de Recherches within the French national radio system in 1951—prehistoric in terms of tape—and all the rest of the material on this disk stems from later work in this pioneer studio by younger students of its techniques.

Predictably, the sounds have very much of a family resemblance. This is a "school" in the time honored sense, precisely like the "school" of a Titian or a Botticelli, out of a common workshop and technique, led by an inspired leader. But, as is often the way in France, there is also a curious crystalization. A style and a manner have been developed; new machinery and new methods merely serve to reinforce the old, adding subtlety and versatility rather than changing the basic idiom. Thus we have here a basic conservatism. Any listening ear can hear it. The new synthetics are utterly different in impact.

In an important way, then, *musique concrete* was a transition stage in the developing new sound arts of our time, probably necessary before the pure sound of the synthesizer could take over. Not merely because synthesizers had to be developed—a major electronic-mechanical proposition. But, equally important, because the very *idea* of assembling sounds via tape manipulation had to grow and spread. And the very best place for that to start was not in the sheer abstraction of synthetic sonics but in the more familiar experience of *concrete* sounds, recorded and then put together into sonic structures.

We have, thus, made a vital progression in these last few years back towards traditional aesthetics in music—believe it or not. Once again, you see, we are working in the older and more pure form of sonic art, the strictly *abstract*, the art of a Mozart. Whereas, like the program music of the nineteenth century, *musique concrete* was a phase where the sonic art tried to forge double meanings, building non-musical, outside ideas and materials into its sound structure. You may find it a bit bewildering to equate, say, Berlioz' *Symphonie Fantastique* or Dukas' "Sorcerer's Apprentice" with Pierre Schaeffer's *Objets lies* which opens the Vox Candide record. But the philosophical similarity is very real and will be ever more so as the Moogs and the Arps and the other music synthesizers proliferate their pure abstractions. In these last twenty years, electronic sound has come a full circle—right back to music itself.

Musique Concrete. (Schaeffer, Mache, Philippot, Bayle, Ferrari, Malec, Parmegiani). Groupe de Recherches Musicales, O.R.T.F., Paris. **Candide CE 3105 stereo** $3.95.

Classical Record Reviews

EDWARD TATNALL CANBY

Walter Carlos and the Well Tempered Synthesizer. (Bach, Monteverdi, Scarlatti, Handel). **Columbia MS 7286 stereo ($5.98).**

This is a mild and proper classical sequel to the famed "Switched-On Bach" efforts by the same Walter Carlos. It won't make the big splash the other one did, but it has more of the same appeal, some really lovely performances—I use the word advisedly—and also some rather untutored renditions, oddly displaying Mr. Carlos' own musical tastes and understanding, just as though he were a live conductor or performer. Once again, we must keep in mind that synthesizers are merely instruments in the hands of human musicians.

The Scarlatti sonatas, four of them, are by far the nicest synthetics on this record. Lovely, delicate textures, yet with the wiry robustness that we associated with Scarlatti in the harpsichord originals. Fine rhythm, excellent phrasing—what else can you ask? Two Monteverdi items are a bit less knowing, just as Monteverdi is a far more difficult composer to interpret today. Quite a little Suite of pieces comes out of the opera "Orfeo" and a movement from the famed—and wildly variously interpreted—Vespers of 1610. Carlos does as well as most conductors in getting sense out of these works, which is to say not very well.

Handel is a surprise. Carlos' "Water Music" is a weird mixture of Sir Thomas Beecham and, maybe, the super-authentic Collegium Aureum orchestra of Germany. I found these items stylistically pretty mixed up—but the "Water Music" is not famous for authenticity in its many current and elderly recordings. As for J. S. Bach, here we have the Brandenburg No. 4, the one featuring two recorders (two flutes in another version). Carlos imitates the recorders most astonishingly, which makes the electronic backing material a bit problematical. This isn't quite up to the super Brandenburg No. 3 on "Switched-On"—but the difference is minor, and the record as a whole maintains the high level of taste and musicianship (considering the medium!) which was so remarkable in the first and more famous Carlos recording.

The Big Steam . . . Union Pacific. Power of the Past! Steam railroad sounds. Howard Fogg, narration and recording. **Owl ORLP-12, ORLP-17 mono** ($4.98 each.)

I'll always fall for a steam RR recording and I ordered these as soon as I caught sight of the listings. Oh-oh, I thought—narration! Who wants an announcer. But to my surprise, the man who "narrates" these two discs, who is also the man who made the recordings, has a most attractive voice and presentation with an almost musical quality of delivery; I kept thinking of the talking blues and, perhaps, Woodie Guthrie. For a born New Yorker he has the darndest non-Eastern accent you ever heard; might come from anywhere between O-hio and Denver and maybe even Californee-ay. Only his occasional bits of attempted drama ("Come on, 754, show the people!") touch on the corn. Inoffensive.

His recordings are not on a par with those highly hi-fi steam offerings from Monitor, on the West Coast, and the fabulous time sequences in stereo made by O. Winston Link. Most date from around 1956 or so, but the later ones seem no different from the earliest and I suspect the same old not-so-hi-fi home-type tape recorder was used straight through. The top end is non-existent and the low bass isn't much; there are overloads and what seem to be tape dropouts, as well as pulses which sound like some species of oscillation. But the old magic is captured nevertheless and many of the sequences are excellent, all of them greatly aided by the matter of fact detailed account of the action, with engine numbers, location, and even the weather included.

The tapes were edited by Mr. Fogg himself in a very casual fashion, without tricks, and my only complaint is that he

has a bad habit of fading out too quickly as the train roars off into the distance. Spoils the illusion! (Like the audio engineers who fade out musical reverb before it has a proper chance to die away of its own accord.) When he joins segments, it is via a quick fade-down and back up again, a straightforward and serviceable procedure. One good feature —probably Owl's idea—is that the speaking voice is recorded at a low level, so that when it is brought up to listening volume the trains come in with overpowering force. Good.

My impression is that the Union Pacific recordings are slightly inferior to those on the "Power of the Past" disc, but the difference is not important. None is hi fi but all are interesting, as well as irreplaceable, being entirely of regular mainline steam operations on major railroads.

Performance: A *Sound:* C+

Rimsky-Korsakov: Antar. Ippolitov-Ivanov: Caucasian Sketches. Gliere: Russian Sailors' Dance (The Red Poppy). Utah Symphony Orch., Abravanel. **Vanguard Cardinal VCS 10060 stereo ($3.98).**

The Utah orchestra under its Swiss

(I think) conductor Maurice Abravanel has done some splendid music making of Mahler, Stravinsky, and other difficult composers—considering that it does not inhabit Chicago, Boston, or Philadelphia. In this relatively popular material, alas, it doesn't do well.

The spirit is OK throughout. That's Abravanel's excellent sense of styling and musical projection. But there is more sloppy, confused playing here than is warranted on any recording, notably in the Antar symphonic suite of good old Rimsky, which sounds as though maybe the men hadn't played it very often before. Probably not—too busy with heavier works! Much is OK, of course. But every so often one gets the feeling that things are maybe going to fall apart, or maybe have never yet quite been put together. After all, a symphonic score, even a semi-pops one like these, is a highly complex sonic machine whose segments must run together like oiled bearings.

For my ear the nicest music is the Ippolitov-Ivanov (one of those stutter-and-stammer names, like Castelnuovo-Tedesco), which pours out as easily as a mountain stream. The Rimsky is, as always, brilliant, superbly orchestrated and hideously contrived out of cliche and cliche—his own. If you've heard one Rimsky movement you've heard them all.

Performance: C+ *Sound:* B

Weber: Der Freischutz. Nilsson, Gedda, Berry et al. Bavarian State Opera and Chorus (Munich), Robert Heger. **Angel SCL 3748 stereo (four discs)** ($24.92)

Here's a potent opera performance but it has its problems. Too international in the styling.

There are two styles of production for big operas these days. One, much the older, is nationalistic: if the opera is German—"Der Freischutz," for instance—then one chooses a German cast, orchestra, and conductor within the local tradition. If it were to be "Carmen," the ensemble would be scrupulously trained in the French manner. Most older operas were written to be produced this way as a matter of course. Singers and conductors stayed home.

Angel's "Freischutz," significantly unlike at least five earlier recordings, is of the star vehicle type so popular today, the mod style in which, thanks to the jet, nations are mixed up as though they did not exist and top-name singers are expected to sing anything in any old language at the drop of a contract. Angel's leading lady, in this very Germanic opera, is Swedish. Her tenor hero, with an Italianate name, is if I am right also Swedish. No matter—they're equipped for German, Italian, French. That's what it takes.

On the positive side there's plenty. This "Freischutz" is the most consistently dramatic and polished presentation on records so far, with never a flagging moment. Things move smartly, the stars sing with enormous gusto, the big scenes positively exude energy and organization, the recording is excellent. Perhaps the biggest triumph, oddly, is the smooth inclusion of a good deal of that spoken German dialog which Weber in the style of his day blended inextricably into the music. Imagine a Swedish soprano and tenor gushing passionate love-German at high speed! They manage it surprisingly well, and the speech-music flow was never as easy as it is here. (In some early recordings there were separate actors for the spoken parts.) Also positively, the secondary roles are taken by German-trained musicians, thereby ensuring a kind of Teutonic foundation for the internationalism. German orchestra, conductor, director, and an excellent and vigorous German chorus from Munich, adding much to the big-scene dramatics.

Yet the performance still is disturbing. The stylistic sincerity of the music, so typical of German early Romanticism, is replaced by what might be called decibel sincerity—the performers surely do put their hearts and souls into the job. But we hear too much of that high-power neutral "opera" style that serves for any old music today, regardless of country of origin. Without even looking at the credits, for instance, I decided that one soprano in the opening scene between the two women on side 3 had a real sense for the German music. She was the Annschen, Erika Koth from Munich. The other sounded to me 'way off-beam, with a non-Germanic voice production, a neutral speech and an unsuitable sliding-up to her notes. *She* turned out to be Birgit Nilsson, the lead, singing Agathe, the top star in the whole production! Similarly, Nicolai Gedda's Max, the very German hero, while impassioned and sincere, sounds Caruso-esque, much too much of an unsuitable Italian-opera style. Puccini—yes. But not Weber.

Though this is the most complete recorded version and the most polished and modern, you should sample one or two of the five earlier recordings (on fewer discs) which offer genuine all-German productions with such superb local sopranos as Seefried and Trotschel for their Agathes and others to match. I particularly remember the Saxon State Opera version under Kempe on three elderly Urania discs, still listed as available.

Performance: B– *Sound:* B+

POPS CLASSICS

Tchaikowsky: Romeo and Juliet. Mussorgsky-Stokowski: "Boris Godounov" Symphonic Synethesis. L'Orch. de la Suisse Romande, Stokowski. **London Phase 4 SPC 21032 stereo** ($5.98)

Pop's classics and classicized pops remain important items in the affluent hi-fi life these days (see prices above) though normally they are not much a classical reviewer's concern. But there is a lot to learn from such disks, on an important border line as to our listening habits.

London's Phase 4 has always hit my ear as a kind of exaggerated American-style stereo, outdoing our classical technique in terms of super-separation and close-up sharpness. (Wide dynamic range, low noise, clarity, etcetc. are to be taken for granted.) In this Stokowski recording, done with the late Ernest Ansermet's Swiss orchestra, the basic Phase 4 parameters are elegantly set forth, as predictable and to be expected. I found the sound rather dry, perhaps as a result of the opera house acoustics in

Geneva, perhaps also a sacrifice of reverb in favor of clinical separation. (It can happen.) The technique, in any case, is excellent for Mussorgsky and "Boris Godunov" (London's spelling) but not good for Tchaikowsky's famed tone poem.

Howcome? Mussorgsky was a brilliant and advanced eccentric in orchestral sonics, who went in for solo color effects in a time that preferred thick, fat sonic mixes, many instruments blended together in chords and melodic lines. As rewritten and slightly exaggerated by good old Stokowski, Mussorgsky is extremely effective under the Phase 4 treatment, which brings out the exotic colors gorgeously, almost as close as your nose. Moreover, the Stokowski orchestral "synthesis," an imaginative musical patch job that makes a continuous orchestral piece out of many excerpts from the whole opera, asks for even more dramatic highlighting —that being a well-known feature of Stokowski music these 60 years and more. So Phase 4 gets high marks for the Mussorgsky-Stokowski.

But Tchaikowsky's sound, in the original format, is basically that of the big blend in spite of its well known brilliance. His chords and most of his melodies depend on a blending-together of groups of instruments to form new colors. Phase 4 just doesn't blend them.

I don't enjoy a big cello melody, for instance, to which is added a bassoon, playing the same tune, yet standing out separately. Ugly and unmusical. It should *blend*. I dislike a loud harp when I should hear only a distant silvery tingle. The famed *pp* drum pulse at the very end of "Romeo" can be superb when you hear it as a sort of pounding heart beat, about to cease forever. Here, it sounds like somebody scratching the drum head with his fingernails about five feet away. Total loss, in terms of the original! A poor sonic translation, so to speak.

Granted—quickly—that close-up microphoning *can* do a musical job, as proved by thousands of examples already recorded. But the edge of good musical taste is a very finicky one and the more so the fancier is your mike technique. I enjoyed this Phase 4 offering for its outspoken sonic presentation, whether plus or minus, and so will you.

Arthur Fiedler/Boston Pops. Motion Picture Classics. RCA VCS 7056 (2 disks) stereo. ($14.96)

Price or no price, motion picture "classics" rate down at the total bottom of a classical reviewer's list. But when Arthur Fiedler chooses to play them, my ears are wide open. That man has a genius for transmuting lightweight orchestral material into dignified and worthwhile musical sound. And, conversely, heavyweight classical into listenable, uncompromised pleasure. He's been doing both for as long as I've been around. There is *no* music like the Boston Pops! Not anywhere.

What do you hear on this double offering? An ennobled sound, is the best way I can put it. So odd, first, to hear these familiar and corny film fanfares, title music, love-backgrounds, etc., done with crisp, brilliant highs and middles, a solid, well structured bass. No theatre speaker (with apologies to Altec) ever had it so good. Superb sound. Then there is the Boston Pops sound in particular, as taken down by RCA—still that huge, warm, golden expanse of realism, all shiny and happy. How do they do it, come thick and thin, mono, stereo, four-channel, what-have-you? Nobody can match it. Not even the Boston Symphony, oddly enough.

Most important is the music. For here, in the corniest of material, is once more

(Continued on page 67)

BEETHOVEN EDWARD TATNALL CANBY

Beethoven: Piano Concerto No. 3 in C Minor; Piano Sonata No. 26 in E Flat ("Les Adieux"). Piano Concerto No. 5 ("Emperor"). Bruno Leonardo Gelber; New Philharmonia Orch., Leitner. **Seraphim S-60130, 60131 stereo** $2.49 each.

If your ears and eyes are tired of stupendously "acclaimed" Beethoven performances, every one supposedly the Ultimate—then take yourself quietly to the nearest record shop and acquire these two modest, modestly priced Beethoven discs (as of this writing they are still listed at $2.49) which to my ear are the finest, most utterly musical versions of the two piano concerti in many years. I would say that this young man is the world's top under-30 Beethoven pianist, and one of the top Beethoven players of recorded history.

Not that the recordings are sensational—just the opposite. What hits you is their astonishing naturalness, an unassuming rightness in every aspect (even the audio), an unaffected transparency of meaning that in this day of studied show biz competition is really a miracle. This is Beethoven himself—the *sense* of his music, absolutely unselfconscious ("Look, Ma, I'm playing Big Beethoven!"), completely communicative, as fresh as though it were all new and wonderful. Like all really great performances, there is almost a daintiness about it, a sense of economy. But the power is there too, and no two ways about it. And the top-rate orchestra is led unfailingly by a man who knows the Beethoven tradition as his own native way of thinking. Superb cooperation.

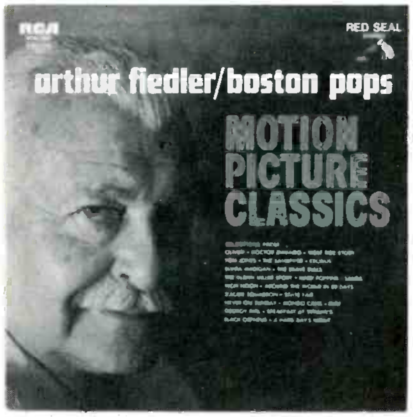
The weirdest aspect of this is that the pianist is wholly foreign to Beethoven's Germany. Bruno Leonardo Gelber comes from, of all places, Buenos Aires. Moreover, much of his training took place there and when he finally did move to Europe for study it was to Paris. Yet, listening here, one might think that Gelber had grown up in Bonn or Vienna, so natural is the Beethoven idiom for him.

Both concerti are immensely appealing but perhaps it is the "Emperor," the famed No. 5, which is the real Gelber miracle. That enormous work is the nemesis for dozens of "great pianists," not to mention great orchestras and their conductors, who bravely or brassily scale its heights and fall flat on their faces. It asks for a truly heroic scale of drama, at an unconscionable length; but at the same time it demands an excruciating effort to avoid overplaying by so much as a hair—for the big piece quickly falls into bathos. It was not one of the composer's perfect works. For all its power and originality it is full of dangerous flaws, moments of anticlimax, long segments of declamatory piano passagework that are the dread of every sensitive player, they so quickly add up to boredom. Many a pianist who surmounts the big climaxes with ease finds himself churning about in these finger exercises, his fine drama tumbling to ruins! Not Gelber. You may at first think his "Emperor" is too modest. But hear him out. He has the whole piece in hand as few pianists ever have in these times. And his orchestra is right with him all the way.

. . . Well, most of the way. You might not know exactly, because Angel made one of those truly imperial booboos in its first edition of this record. Side 1: the long first movement complete. Side 2: the long first movement all over again! How *could* it have happened? The "Emperor" was hastily reissued in a corrected edition—but better look to be sure. Concerto No. 3 is complete as composed, and its disk is filled out with a splendid extra in the solo piano sonata "Les Adieux" which will give you a close-up of the dramatic power that this modest pianist has at his call. Helps explain why the concerti go so well.

Performance: A **Sound: B+**

that almost chaste perfection of playing which under Fiedler can always be taken for granted. Somehow, other conductors look down on pop music; they degrade whatever they touch, good or bad, in the interests of box office schmalz. Never Fiedler! His players are not only perfect in performance but they *sound interested*—they play with fervor, concentration, pride. You can hear it. In funny music



they are far funnier, thanks to this. In serious music they radiate musical charm. In corn, they elevate.

Nope. I didn't play four straight sides here. But I heard plenty to convince me that if the hard working composers of film music really want to hear their efforts at a lofty best, they had better forget their films and listen right here. *They* never had it so good.

Performance: A *Sound:* A–

COLLECTIONS COMPLETE

(An honest note: By the time the following were conscientiously played through and evaluated, the entire lot would long since be ancient and out of print. Better, at least, to mention them—in time! Some will also be reviewed, as digested. E.T.C.)

Beethoven: The Five Piano Concertos; the Choral Fantasia. Barenboim; John Aldis Choir, New Philharmonia Orch., Klemperer. **Angel SD 3752 (4 disks) stereo.**

Beethoven: The 32 Piano Sonatas. Barenboim. **Angel SNLV 3755 (14 disks) stereo.**

Ravel: The Complete Music for Piano Solo. Samson Francois. **Seraphim SIC 6046 (3 disks) stereo.**

Mozart: The Complete Music for Piano Solo. Walter Gieseking. Vols. 1, 2, 3. **Seraphim ID 6047, 6048, (4 disks each IC 6049 (3 disks) mono.**

To be Continued

LIGHT LISTENING

SHERWOOD L. WEINGARTEN

MOVIES MAY NOT BE BETTER than ever (unless you happen to be a voyeur and dig what the flesh peddlers are pushing), but film sound tracks seem to be. At least, the recordings have broken out of their traditional molds and now are offering a variety of material (not excluding snatches of dialogue).

Whereas sound track LPs once brought to mind a single theme (that usually was repeated a dozen times, with only the stringed accompaniment changing now and then), they now present myriad tempos and styles.

Case in Point: THE MAGIC CHRISTIAN (CUR, CU6004), extracted from the flick starring Peter Sellers and Beatle Ringo Starr (and, for the oglers, showcasing the charms of Raquel Welch).

Best of the 13 cuts is the catchy "Come and Get It," a 2:19 rocker rendered by a group called Badfinger, a Beatle discovery that has thrust the tune up the charts. The song, which is reprised briefly on the flip side (in concert with dialogue), was penned by Beatle Paul McCartney, the lively ghost.

Badfinger also performs "Carry On to Tomorrow," a soft-rock ballad of sorts that is reminiscent of the Simon & Garfunkel sound and does not seem nearly as long as its actual length (4:44), and "Rock of Ages," a heavy piece with magnetic, driving beat that virtually could make hardened arteries flexible (the frenzy of guitar, drums, and rinky-tink piano is phenomenal).

The sound track of the film based on the Terry Southern novel also spotlights a couple of swingin', spoofin' novelties. "Mad About the Boy," the Noel Coward classic, is turned into a hiliarious bit via vocal in limp-wristed format, and "Lili Marlene" parodies the sultriness of Marlene Dietrich and company.

The bulk of the score, written by Ken Thorne, is superimposed on squibs of dialogue—or vice versa. Most effective is "Hamlet Scene," where conversation leads to an interlude of Baroque chamber music, and a segment of the soliloquy is juxtaposed with a Dixie melange that conjures visions of a stripper. "Magic Christian Waltz" is another good example of merging of dialogue and music, the melody being an oddly pleasant combination of waltz tempo and Latin strains.

Two other tracks are worthy of attention: "A Day in the Life," an instrumental, spotlights big orchestration that's heavy on strings and sax work and ends with a resonant piano exercise, and "Something in the Air," featuring a chopsticks-like piano section that at first is jarring but later metamorphoses into a good, rhythmic jazz featurette.

If there is a message in any of the music, incidentally, it is in the latter piece: "We have got to get it together now," it exclaims desperately, and then adds, "the Revolution's here and you know it's right."

Obviously aimed at hip young people, the sound track is a musical potpourri that can appeal to anyone with an open mind and some toes ready to tap.

° ° °

A 50-year-old Manitoba native continues to defy musical trends by singing the kind of folk tunes that were popular in the '50s. Somehow, though, he manages to draw large audiences and make them forget that rock and blue are where it's at. Witness OSCAR BRAND ON CAMPUS "LIVE" (Kapp, KS3624).

Brand, who accompanies himself on banjo, performs 11 tunes, all but two of which he either wrote or re-wrote. The result can be told in a word: Fun. And the appreciation can be measured easily by the laughter and applause of the crowd at MacDonald College, Ste-Anne de Bellevue, Quebec, where the disk was taped.

The folksinger, who sang with the greats of the genre (Pete Seeger, Woody Guthrie—that's Arlo's late dad, teeny-boppers!—and Leadbelly), has penned ten books on music and recorded 52 LPs (including the nine-disk series "Bawdy Songs and Backroom Ballads")—so his credentials are obvious. Even if they were not, his casual but studied way with a song would be sufficient.

The emphasis is on light-hearted material such as "My Old Man's a Sailor," a Brand original that became a tongue-twisting hit for the Smothers Brothers. Enjoyment persists throughout the five-minute winner. And try on for chuckles "The Complete Foggy Dew," which stresses risque lyrics not heard in most pop versions; the sing-song doggerel of "Parties," which features audience participation in a collegiate boo-rah gambit, or the word plays of "Squid-Jiggin' Ground" (the shortest track, at 1:52).

Brand can also inject pathos, as in "When I First Came to This Land," or chauvinism (as with "Something to Sing About," the Canadian counterpart to Guthrie's "This Land Is My Land").

Contrasting are a bouncy sea chanty, "Lotsa Fish in Bona Vista Harbour," and a tune with a Scottish lilt (a Highlander bagpipe sound is simulated by whistle and guitar), "Banks of Sicily."

But the best cut is the only one on which the singer interjects satirical social comment, "The Atomic Talking Blues." Utilizing the traditional narrative format (also frequently used on vinyl by Seeger), Brand notes that "peace is a very very good thing. Of course, there are people who will kill for it." And he chides: "Whether you're black, white, red, or brown, the question's the same when you boil it down: To be or not to be, that's the question."

"Here's my thesis: Peace in the world or the world in pieces," he talk-sings, noting that with the Bomb hanging over our heads, "We hold these truths to be self-evident . . . all men can be cremated equal." Not a Brand-new thought, or a new Brand thought, but one worth considering.

° ° °

GINETTE RENO (Parrot-London, PAS71032) is a thrush with whom I am unfamiliar. But hopefully that will change, for her voice is the kind that lingers in the audiophile's mind. With great showmanship (that must mesmerize a live audience), she performs a dozen tunes in a style not unlike that of the Down-Under gal, Lana Cantrell.

Miss Reno, who is lauded on the album cover by Englebert Humperdinck, offers a mixture of chartbusters and obscure tunes. Almost all have one thing in common: Professional, exciting renditions (aided, undoubtedly, by the arrangements of the musical director Johnny Harris).

The songstress, whose voice sometimes contains a hint of an accent, projects with a slight huskiness that is hard to reconcile with her child-like face, big eyes and pixie-like, close-cropped dark hair. Still, the listener is pleased—and that, ultimately, is all that matters.

Side One includes the Academy Award winner, "Windmills of Your Mind," which sweeps across the stereo like a clear breeze; "If You Go Away," which captures all the intensity of the Jacques Brel-Rod McKuen tune without becoming maudlin; "In the Year 2525," a Top 40 repeat that is far superior to most of the junk that is polluting the airwaves (the heavy beat, echo quality of the vocal, and strong strings mesh exquisitely), and "Without Him," a Latinized success. Only "Everything That I Am," with a somewhat gimmicky, cluttered arrangement, does not work.

On the flip side, "Don't Let Me Be Misunderstood" is a fantastic showstopper (after a flashy guitar intro, it becomes quasi-rock, the mod-ern beat complemented by zesty strings); "I'll Be Loving You," overdubbed for multi-voice effect, and "You Made Me So Very Happy," which slips easily from slow to fast tempos.

I just figured out why she appeals to me, what it is that she has that is so rare—*talent*. Listen!

* * *

Television made Tom Jones the superstar he's become; it is likely the medium that will transform Johnny Cash into the same caliber of box-office attraction . . . even though his gruff baritone is limited in range and makes too many melodies sound just like the last one he performed.

HELLO, I'M JOHNNY CASH (Columbia, KCS9943) is an LP that is sure to Cash in on the vidiot show. Pure country corn planted by the singer, his wife (the former June Carter) and a background combo, The Tennessee Three.

Cash, who exudes enough sex appeal—with an antiquated idea of what masculinity is—to draw a heavy percentage of wide-eyed female listeners, is as unimaginative in his self-accompaniment on guitar as he is vocalizing. Still, as the ad man said, he must be doing something right. And it isn't *all* bad.

Four tunes on the first side are Cash originals. "Southwind," with a good, twangy instrumental backdrop, is reminiscent of a steady, staccato train ride; "'Cause I Love You" is a lively duet with his wife; "Route No. 1, Box 144" is a talk-singfest reeking with sentimentality, and "See Ruby Fall" (penned jointly with Roy Orbison) is a bland but popular outing.

"The Devil to Pay" is typical Cash—a tune sung in a rough low range that you know he can't better, and "Wrinkled, Crinkled, Wadded Dollar Bill" is a typical song-of-the-road/lonesome blues. "Sing a Traveling Song" is effective because of a solo female voice humming in counterpoint, and "If I Were a Carpenter," the Tim Hardin composition, is a superior duet. "To Beat the Devil" is narrated as much as it is sung; "Blistered" is a rapid-paced ditty by Billy Edd Wheeler; and "Jesus Was a Carpenter" spotlights excellent lyrics that take pot-shots at the commercialism of religion.

Cash climbed to the pop top partially via his image of an anti-hero, he-man—a scar-faced singer who is an ex-con. The public cared not that the scar didn't result from a barroom brawl (a tumor was surgically removed), or that his longest jail stay was overnight. Oh well, to paraphrase an old matchmaking gambit, his singing doesn't look like much, but boy, what a *personality*.

* * *

I like the kid but he still sounds to me like an ex-choirboy whose voice hasn't quite changed. And somehow his disk-work doesn't have nearly the impact as his personal appearances.

Even the combination doesn't come off. Witness WAYNE NEWTON LIVE AT THE FRONTIER, LAS VEGAS (MGM, SE-4608), a recording with 14 tracks (including three medleys). Although Newton offers variety, the session flops—perhaps because of overwhelming orchestration at times, perhaps because of too much banter and too little singing, perhaps because of a coupling of ill-fitting numbers in medleys, perhaps because of insufficient editing (or none at all). Whatever the reason, this is probably his worst recording to date.

It starts with "Gentle on My Mind," wrecked by a breakneck pace that is neither country nor rock—rather, a bastardized nitery rendition with blaring sounds emanating from the musicians in Al Oliver's pit band. The rhythm section is particularly overwhelming.

"Wichita Lineman" follows and is more graceful, better suited to the youngster's ability. But next is a medley, "Goin' Out of My Head/Can't Take My Eyes Off of You," which, by virtue of the slow-fast alignment, fails. Later, "Bill Bailey" fits the raucousness of the setting (the tune is introduced as a "Bolivian folk song," is mis-directed as a horribly-accented "Hava Nagila," and finally turns into a wild nothing). "What Kind of Fool Am I?" is a smooth number until the orchestra remembers, at the end, where it is and tries loudness as a remedy to tinkling glasses.

On the flip side is the one piece that is a total success, "Scarlet Ribbons." The musicians remembered they were backing a singer; Newton remembered he could sing and didn't have to act the clown or a saccharine emcee, and the arrangement is soft and low-keyed. With the exception of "Orange Blossom Special," a vocal-less fiddling extravaganza (though brief), the rest is depraved. Newton breaks up midway through "Love Makes the World Go Round," then starts again; "Harper Valley P.T.A." is a cacophony that destroys the impact of the biting lyrics: "When the Saints Go Marching In" is hell-bent to break a few eardrums needlessly. Etc., etc., etc., and so forth.

Jack Benny "discovered" Newton; perhaps he'd better recall him for some lessons in why the youngster shouldn't try to become the Milton Berle of song.

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Audioclinic

(Continued from page 4)

simply cannot supply sufficient power to fill the car without producing distortion. Naturally, the mismatch of impedances results in somewhat less power being transferred to the speakers than would otherwise be the case. Further, if these speakers are relatively inefficient, this would add to your troubles. The obvious cure for the problem is to use speakers having the proper impedance, obtaining units which are as efficient as you can find. The only other solution is to use larger, more efficient 8-ohm speakers than you added. This will give you more overall sound in the car and might in the end provide better sound than could have been produced merely by changing your original speakers to 3.2-ohm units. I realize that adding larger speakers is not always easy because of the limitations imposed on you by the physical layout of the automobile.

If it should happen that one set of speakers is more efficient than the other, as is apparently the fact now, you should consider using a T-pad at the more efficient speakers so as to equalize the volume between the speaker sets. Ideally you should use the same kind of speakers that you now are using as the original. At least this will eliminate all problems arising from differing efficiencies.

Recorded Tape Reviews

BERT WHYTE

Mahler—Das Lied von der Erde—Nan Merriman, mezzo-soprano, Ernst Haefliger, tenor, Eugan Jochum conducting the Concertgebouw Orchestra, Amsterdam DGG 923 112, **cassette,** ($6.95)

This performance of Mahler's heartbreakingly lovely "Song of the Earth," was praised by some critics and damned hy others. In the case of Mahler recordings, this is par for the course. I don't think there are many instances where there was very much unanimity of opinion on any combination of artists, sound, etc. As far as I am concerned there is room for several viewpoints, and each performance has different points of superiority, which makes for interesting listening. In any case, I get so enthralled by this music, I generally like what I hear. This recording has the advantage of generally nice clean sound, except for a little distortion from trumpets and horns in some of the forte sections. The voices are well-projected in good balance with the orchestra in a hall with broadly spacious acoustics. I noted exceptionally good bass response. Once again tape hiss is low for a cassette, but still is an obstrusive and limiting factor. Dynamic range on cassettes is said to be limited at present to about 35-40 dB (and that under ideal conditions). Some seem a bit wider as does this cassette, but of course at the expense of covering the pianissimo sections with hiss. Now with the consumer Dolby System launched, this paves the way for Dolby-ized cassettes and that 10 dB of noise reduction, which will force a general upgrading of cassette techniques, will make all the difference in the world. Big plus factor in these DGG cassettes are the very few dropouts that are encountered and freedom from mechanical problems. At "apartment house" listening levels the sound on these cassettes is eminently satisfactory.

Johnny Dollar—Big Rig Rollin' Man Ampex/Chart M51023, **cassette,** ($5.95)

Is Johnny Dollar the poor man's Johnny Cash? I hardly ever listen to this country/western type of music, but I was amused by the name of the performer and the title song . . . "Big Rig Rollin' Man". This turns out to be sort of a collection of ballads concerning truck drivers . . . their deeds and their laments. Some of the lyrics are very funny and the whole thing is sung in typical C/W manner with Johnny Dollar pleasant-voiced and more articulate than most of his contemporaries. He gets a better-than-average accompaniment too, from his instrumentalists. I drove a big rig on a round trip between New York and Denver (once and never again!) so I can appreciate some of the sentiments expressed. Of its type, good clean sound, moderate hiss. This recording should make a bundle, as I'll bet numbers from it are on the juke boxes of truck stops all over the country.

Barbra Streisand — "People" Columbia 16100020 **cassette,** ($5.95)

If you dig Barbra, this is for you. A better than her usual average collection of ballads with hits like "Absent Minded Me," "Fine and Dandy," "Autumn," and of course her blockbuster, "People." The recording is very clean and the voice well-recorded. One thing I want to bring to your attention is quite startling. Barbra sings one number called "How Does The Wine Taste," sort of a torchy thing, and quite unexpectedly and seemingly completely out of place in such a song there is a tremendous bass drum! Not only is it out-sized in impact, but it is exceptionally well reproduced. Coming from a cassette is all the more amazing. Certainly it is not a reason for owning this cassette, but it is an interesting oddball sort of thing you hardly expect to encounter in this type of recording.

Eighteenth Century Trumpet Concertos—Maurice Andre, Trumpet, Rouen Chamber Orchestra conducted by Albert Beaucamp Ampex/World Series X9049, **open reel, 3¾ ips,** ($5.95)

There are trumpet concertos by Leopold Mozart, Telemann, Albinoni, and Vivaldi on this tape, and they are performed with stunning virtuosity by Maurice Andre. Mr. Andre has a big confident tone and evidently complete technical command of his instrument. Much of the playing is in a very high register, which Mr. Andre traverses with ease. The music is interesting, mostly transcriptions for trumpet from works written for other instruments. The trumpet is nicely in balance with the strings, well projected in a solid center-channel image. The hall has big live acoustics and in common with many such concertos, the acoustic intensity of the trumpet makes it appear as if the trumpet is in a more spacious environment than the strings. The overall sound is very good for a 3¾ ips recording. Strings and trumpet are quite clean and wide range. Tape hiss was moderate at room-filling level, there was no audible crosstalk, but there was some print-through, especially with some of the hard transients of the trumpet.

The Glory of Gabrieli—E. Power Biggs, organ; The Texas Boys Choir; The Gregg Smith Singers; The Edward Tarr Brass Ensemble; Vittorio Negri, conductor Columbia cassette 16110148, ($6.95)

I have heard this splendid Gabrieli music on open reel, 8-track cartridge, and some of it in 4-channel stereo, and now on cassette. I am astonished how well this big-scale, highly dynamic music fares on this medium. The big choral sections and brass chorales and organ pedal are reproduced with commendable fullness with very little distortion. The recording was made in the Basilica of San Marco in Venice, and a special pat on the back must go to the engineers who coped so well with the tremendously reverberent acoustics. Tape hiss is of course, omnipresent and irritating in the quieter sections. However I noticed surprisingly little print-through and relatively few dropouts. If you haven't heard this music you're missing a real treat.

8-Track

Bizet/Shchedrin—the Carmen Ballet. Arthur Fiedler conducting the Boston Pops RCA R8S 1141, **8-track cartridge,** ($6.95)

This special arrangement of Carmen by the Soviet composer Shchedrin, gained considerable fame as a demo vehicle when it first was heard in this country on an Angel/Melodiya recording, principally because of the tremendous percussion battery involved. In this first American recording no less than 47 percussion instruments are used. You name it . . . drums, cymbals, gongs, chimes . . . it is in this recording somewhere. Unfortunately, a rather overblown, over-reverberent acoustic perspective dilutes a great deal of the impact and excitement of the percussion. The playing is of the usual high quality expected of Boston Pops.

. . . Negative Feedback

(Continued from page 36)

tend the turnover point down from 20 Hz to 1 Hz. This requires a 5 μF capacitor.

Now for the capacitor between input and middle stage. In each circuit, this feeds from 1K into about 4K total, so requires a reactance of 5K at 2 Hz. For this, 20 μF would be adequate, but a 25 μF will give some margin.

The input capacitor, like the output, works between two 500-ohm impedances, so 100 μF should be used. As the base is above ground, negative should go to base on the input capacitors, for the other capacitors, negative should go to collector.

In both these circuits, only one capacitor is contained within the feedback loop, so there is no stability problem. Also no base, except the input stage, has a very high impedance so that a peak can push it beyond cut-off and cause blocking that has a long time delay before operation is restored. If there is any risk of a peak seriously in excess of the rated 10 mV input level, it may be well redesign the input stage with a base-to-ground resistor.

With a base-to-ground resistor of 1K, the base input impedance must be adjusted to 1K, so the combination makes 500 ohms (Fig. 4). The 1K resistor will take 10 microamps of the input signal current, so the transistor must deliver its required output from 10 microamps input, instead of 20 microamps in the previous figuring.

So the feedback current needs to be 8.26 microamps, instead of 18.26, setting the value at 18K. The emitter resistor passes a signal of 182 microamps at 10 mV, for which a 56-ohm resistor is satisfactory. This change has another advantage: it will work the input stage at lower current, giving a larger margin of voltage swing in the other direction.

In the last two articles of this series, we have taken what could have been a rather complicated design, and finished up with a fairly simple and highly stable circuit. The problems were resolved fairly simply—at least it seems so afterwards, but then most problems do! In later articles, we'll explore some other avenues of transistor-circuit design. Æ

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FREE Catalog: Low-priced, high-performance subminiature listening devices direct from manufacturer. Dealers welcome. Audiotronix Adm. 7, 156 Fifth Avenue New York, N. Y. 10010.

IMPROVED SHURE V15-11, $47.00 and your old cartridge, shipped prepaid. The Stereo Shop, 1201 Ellis, Cedar Rapids, Iowa 52405.

TAPE RECORDING MAGAZINE—Enthusiasts monthly magazine for amateurs and professionals. Send 3.75 for 1-year subscription to 1, Alverstone Ave., East Barnet, Herts, England.

AMPEX 602 Transport with AG600 ¼-Track Head Assembly. No electronics. Like New, $350. Citation B Amplifier, $190. Box 1482, Arlington, Texas 76010.

HARTLEY CONCERTMASTER IVA's (2) used three months as floor demonstrators —⅓ off, trades accepted, write or phone Stereo Center, 218 Columbia St., Utica, N.Y.

CUSTOM SPEAKER CABINETS to your specs., and duplication of any discontinued enclosure. Price list available. Custom sound systems installed in Wash., D.C. area. Custom Audio Components, 3921 Lantern Drive, Wheaton, Md. 20902. (301) 942-8540.

Becaud Opera D'Aran, Angel Stereo 3637, 2 new copies, make offer one or both. Also 1 new Decca/England 4RC Cartridge. BaBisson, 311 Goodley Road, Wilmington, Del. 19803.

FOR SALE

SPECIALTY PRODUCT business for sale. Indispensable tape recorder accessory with wide appeal and high profit margin. Stock, dies, molds, packaging, advertising, trade mark, pending patent. No assembly required. Complete basis for a mail order business or trade distribution. for $10,000. Excellent opportunity to acquire new product line or to establish own HiFi business, for company or person who knows HiFi (we don't!). Crescent Fastener Co. (established 1961) Box 1023, Darien, Conn. 06820. Tel. (203) 866-4123.

2 AM-10 **Ampex** Mixers (brand new, never been used). 2 **Langevin** PS4900 power supplies, 1 brand new. 1 **Langevin** EQ 251 used. 1 **Langevin** graphic EQ used. 6 **Langevin** 4700 amps & trays. 6 **Langevin** AM 16 amps. 8 **Langevin** AM 17 amps. 1 **Fairchild** 663 compressor used. 6 **NTF Freed** Transformers. 1 **Ampex** PR-10-1 Only slightly used. Sell all or partial to best offer. Ray Harris, Crusade Recording Studios, Flora, Ill. Phone 618-662-3521.

CROWN MUS-O-MATIC stereo tape player, $250. AR amplifier walnut case, $150. Citation III-X stereo tuner, $70. Fisher R-200-B stereo tuner, walnut case, $195. Blonder-Tongue Audio Baton, $25. Local only. Phone 201-625-0432.

JAPAN & HONG KONG DIRECTORY. Electronics, all merchandise. World trade information. $1.00 today. Ippano Kaisha Ltd., Box 6266, Spokane, Washington 99207.

SENNHEISER Condenser Microphone, MKH 104, new unused, extras like a.c. transformer, 50 ft. cable, cost $300, sell for $150. L. Goodfriend, 221-45 L.I. Expwy, Bayside, N.Y. 11364.

BLANK 8-TRACK CARTRIDGES. Do Your Own Recording on 8-Track Cartridges. Write Stereo Shack, Box 794, Miami, Florida 33143.

KLIPSCH, TANNOY, BOZAK, MARANTZ, THORENS, RABCO—No Discounting—Superior Sound, 1801 Brewerton Rd. (Rt. 11) Syracuse, N.Y. 13211.

2 **JBL** 600-Hz crossovers, $55.00 or trade for N1200's. Al—692 S. D St., Tustin, Calif. 92680.

TAPE TIMERS: The professional way of synchronizing tape movement with timing accuracy. PRO Model 15-7½ ips $99.95. Standard Model 7½-ips $49.95. Write for catalog. TIMEKEEPER, Box 762, Mineola, N.Y. 11501.

BACK DATE MAGAZINES! Send needs. Midtown, Box 917AU, Maywood, N.J. 07607.

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DISK RECORDING EQUIPMENT: Complete mono and stereo cutting systems featuring rebuilt Scully, Neumann, Van Eps, and Fairchild lathes and new W.A.L. amplifiers. Priced from $2500.00 Wiegand Audio Laboratories, 3402 Windsor Road, Wall, N. J. 07719.

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CASH FOR YOUR unwanted LP's and prerecorded tapes. Record House, Hillburn, New York 10931.

WANTED, 3-channel prerecorded tapes compatible with Nortronics 5701 head. Send information. Norman Fleming, 145 Hillside Ave., Villanova, Pa. 19085.

WANTED: Recording of Lily Pons's San Francisco **La Traviata.** Please write to Phillip Polite. 950th Ninth, San Diego, California 92101.

Sell your old **PLAYER PIANO ROLLS.** Cash Now. Art Faner, 11774 Quam, Denver, Colorado 80233.

WANTED: mono or stereo disk cutter head. Condition unimportant. Peter Y. Ng, 24-417 M.I.T., Cambridge, Mass. 02139.

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MAKE BIG MONEY raising chinchillas, rabbits, guinea pigs for us. Catalog—25¢. Keeney Brothers, New Freedom, Pa. 17349.

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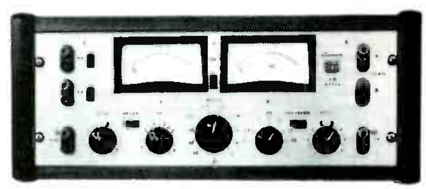
MA5100 Ser. No. 53H92 Pittsburgh, Pa., on 2/6/70. Contact B. R. McAvoy (412) 621-2791.

NEW IM ANALYZER

ADVANCES STATE OF THE ART

Extended measuring range and high-speed readings are the outstanding features of a unique new Intermodulation Distortion Analyzer introduced by Crown International recently. The American firm is known for its line of Crown precision professional tape recorders.

This analyzer was developed to meet the production line requirements of the Crown DC300 lab standard amplifier. The first need was for accurate measuring capability through 0.01%. This analyzer guarantees a residual IM level of less than 0.005%, with seven full-scale ranges from 100% to 0.1%.



The second requirement was for an instrument simple enough to be operated by production-line personnel and rapid enough to make sequential readings across the entire power band. The Crown analyzer meets the challenge by reducing measuring time from minutes per reading to just seconds. This is accomplished by a "tracking" function, using two meters and a ganged input/output gain control. The input level is set using the calibrate meter, and distortion is immediately read on the percentage distortion meter. Successive readings at 5db increments take under five seconds each. The entire operation is completed in less than one minute.

Solid state construction, utilizing FETs, makes the Crown analyzer highly stable and uniquely compact, measuring 7x19x7 inches. Rack mount list price is $595. Write for spec sheet to CROWN, Dept. A-5 Box 1000, Elkhart, Indiana, 46514.

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Advertising Index

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May 1970 Issue

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9			24			39			54			69			84			99			114			129		
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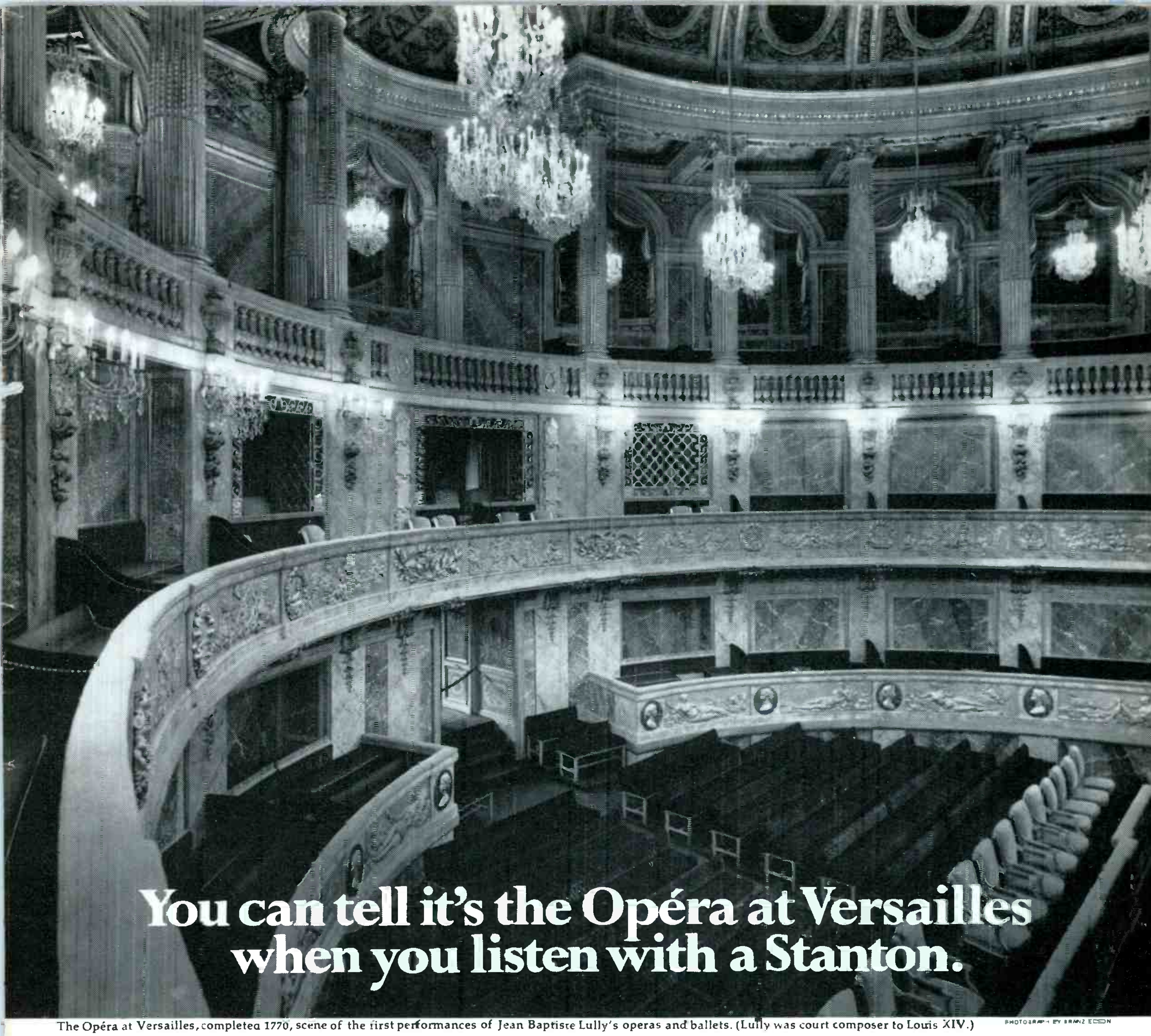

The Opéra at Versailles, completed 1770, scene of the first performances of Jean Baptiste Lully's operas and ballets. (Lully was court composer to Louis XIV.)

PHOTOGRAPH BY FRANZ EDSON

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

It's the sound of the hall.

Many of today's smoother, better-tracking cartridges can reproduce instrumental and vocal timbres with considerable naturalism. But something is often missing. That nice, undistorted sound seems to be coming from the speakers, or from nowhere in particular, rather than from the concert hall or opera stage.

It's easy to blame the recording, but often it's the cartridge.

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

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

The Stanton does. **Stanton**

The specifications.* Frequency response from 10 Hz to 10kHz, $\pm 1/2$ dB. From 10kHz to 20kHz, individually calibrated. Nominal output, 0.7mV/cm/sec. Nominal channel separation, 35dB. Load resistance, 47K ohms. Cable capacitance, 275 pF. DC resistance, 1K ohms. Inductance, 500mH. Stylus tip, .0002" x .0009" elliptical. Tracking force, $3/4$ to $1\,1/2$ gm. Cartridge weight, 5.5 gm. Brush weight (self-supporting), 1 gm.* Each Stanton 681 is tested and measured against the laboratory standard for frequency response, channel separation, output, etc. The results are written by hand on the specifications enclosed with every cartridge. The 681EE, with elliptical stylus and the "Longhair" brush that cleans record grooves before they reach the stylus, costs $60. The 681T, identical but with interchangeable elliptical and conical styli both included, costs $75.

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

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Remember how tape used to sound? You'd turn up the volume and hear a background hiss — or turn it down and not hear the sound. With new BASF-LH tape (Low noise-High output) you eliminate all background noise and you get full-bodied, dynamic tones over an expanded volume range. The signal-to-noise ratio is improved by as much as 8 db over other low noise tapes.

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