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AUDIO

JUNE
1971
60c

The Authoritative Magazine About High Fidelity

Dolby For FM

Hi Fi at the Playboy Mansion

Feldman on Hi Fi Outdoors

110 dB Dynamic Range on Tape

Don Davis - Amplifier Power

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but don't want others to know

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Check No. 100 on Reader Service Card

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AUDIO

Successor to RADIO, Est. 1917

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FEATURE ARTICLES

EQUIPMENT REVIEWS

RECORD AND TAPE REVIEWS

AUDIO IN GENERAL

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Coming In July

Buyers Guide to Microphones

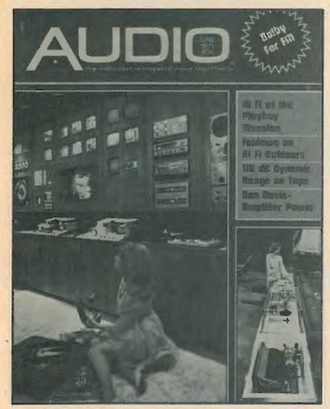
Highlights of the Eastman Recording Workshop
by Paul Dean

A wide-range sweep oscillator
by Michael Lampton

Performance capabilities of dynamic and condenser microphones by Richard Fowle

Equipment Reviews
Including:
Nikko 1200 amplifier
Acoustic Research FM tuner
Garrard Zero 100 turntable

Plus
Record Reviews
and
all the regular features



About the cover: This shows some of the audio (and visual) equipment installed in Hugh Heffner's Playboy Mansion. Total value exceeds $375,000, not including the Bunny.

Audioclinic

JOSEPH GIOVANELLI

New "High Energy" Tape

THE 3M COMPANY'S Magnetic Products division has announced a new product line in the family of 3M magnetic tapes—High Energy tapes. The qualities of these tapes for video and sound recording are striking.

Most TV commercials are recorded on video tape, and the copies actually seen by the viewer at home are fourth generation copies. While these copies are good, they are not as good as the original masters from which they were made. The deterioration is the result of the noise build-up which takes place each time the tape is copied.

Mr. Daniel E. Denham, the division's general manager, introduced the tapes at a press conference:

"What was needed was an oxide which could provide a meaningful increase in output so that a greater signal-to-noise ratio could be provided. The greater output was achieved through an increase in the magnetic properties of coercive force and remanence, in turn accomplished by introducing a small amount of cobalt into each particle of oxide. This is done in a manner that allows the control of the resultant coercive force to a predetermined level.

"The products in which these new oxides are used are referred to as High Energy tapes because of the higher output that can be derived by the proper application of this new recording medium."

Mr. Denham indicated that the typical video tape has a coercive force of 300 oersteds. The new video tapes will have coercive forces of approximately 500 oersteds and will be compatible with present video recorders. A coercive force as high as 900 oersteds is possible, and these oxides will find wide applications in recorders of the future.

4 dB S/N Increase

By increasing the coercive force from 300 to 500 oersteds, a 4 dB increase in output is achieved, directly translatable into a 4 dB increase in signal-to-noise ratio. The standard video recording tape has a signal-to-noise ratio of 50 dB and the noise build-up proceeds at the rate of 1.5 dB each time the tape is copied. By the time the tape is fourth generation (copied three times), the signal-to-noise ratio would then be 4.5 dB lower than that of the original master, or 45.5 dB. By using the new High Energy video recording tape, 4 dB more output is available, thereby increasing the signal-to-noise ratio from 50 to 54 dB. It is true, of course, that the fourth generation copy will be 4.5 dB below this 54 dB. However, the signal-to-noise ratio will still be 49.5 dB. This is just 0.5 dB below the 50 dB signal-to-noise ratio obtained when making masters on conventional video tape.

Mr. Denham said that by using this High Energy tape on home video recorders, broadcast quality is achievable. A demonstration certainly supported this. However, to make home video recording more economical, it would be better if video recorders could run at slower speeds. Mr. Denham stated that, as the coercivity is increased, the high frequency response of High Energy tape can be actually better at half speed than the standard video tape at normal speed.

Audio Tape Too

The same improvement in performance shown for video tape is also available in sound recording tape, according to Mr. Denham.

"In fact, this new High Energy cassette tape yields an output that is 3 to 5 dB better across the entire spectrum than competitive products. Just as was true with the examples shown for video tape, the increased output of the new cassette tape renders a greatly improved signal-to-noise ratio. This 3 to 5 dB increase in dynamic range is quite noticeable to even the casual listener. When the playback level is set so that the program material sounds as loud as the competitive cassette, tape noise has dropped a dramatic 5 dB.

"The most astounding part is that all the advantages of increased output, improved frequency response, and broadened dynamic range can be realized on existing recorders without modifications."

After the conclusion of the formal presentation, Mr. Denham answered a few questions from the floor. The facts which were derived from these questions are: No audible range reel-to-reel tape is to be made available in the immediate future. The High Energy tape would have little advantage at tape speeds of *7.5 ips and higher,* however, open reel tape might be made available for those wishing to make slow-speed recordings. After all, many home recorders operate at speeds of 1⅞ ips. The video tape is available right now; the cassette tape will be available by approximately July 1.

Power Ratings

Q. I have a question about power ratings. Please explain the difference between IHF, rms, and peak power. Also, if a person knows one power rating on a piece of equipment, is there a formula with which he can find out the other power ratings for that particular piece of equipment?—David K. Phillips, Jr., Fayetteville, N.C.

A. In order to have an idea about power ratings, we ought first to discuss alternating current. At any given time the current might be zero, maximum in one direction, maximum in the opposite direction or any value between these extremes. If current alternates, so does voltage. Because voltage times current equals power, power also varies. If we take the moment when power is at its maximum, we can say that this is the peak power produced by this circuit. Note that we are not concerned with the direction of power, but only in its instantaneous peaks. We sometimes need to become aware of the phase relation between current and voltage. We shall not concern ourselves with this situation in this particular discussion. If we average out all the variations in power from zero to maximum, we arrive at the (root means square) power which turns out to be half of the peak power.

We can double the apparent power of an amplifier merely by adding the power developed by one channel to that produced by the other. This gives twice the actual power produced by a single channel. When thinking in terms of a suitable loudspeaker system, it is good to know whether we are talking about the power delivered by a single channel or that delivered by the complete amplifier.

Now we come to IHF power, or music power. This is a concept which is tricky to explain. When we attempt to operate an amplifier at full power, especially with both channels driven, the power supply is often not sufficiently well designed to enable the amplifier to produce this full rated power. The voltage from this power supply falls off. The more it falls, the less power it will produce without serious distortion. However, some engineers state that most musical peaks, where sudden, transitory demands for power are required, pass so quickly that the power supply's filtering elements will maintain full voltage during these transient peaks. The person testing the equipment notes the power supply voltage before signal is applied to the input of the amplifier. He then drives the amplifier to full output, but raises the voltage to the amplifier to compensate for the fall-off in power supply voltage. This provides greater power output, and for a long enough time so that it can be measured. Transient power peaks are difficult to

(Continued on page 76)

Tape Guide

HERMAN BURSTEIN

10½" Revox Reel Adapters

Mr. John C. Kountz, 1065 Van Dyke Dr., Laugna Beach, Calif. 92651, writes: In the March issue of AUDIO, I noticed an inquiry about large reel adapters. I manufacture such adapters, nominally priced at $3.00 a pair, and I would be more than happy to ship them anywhere in the world. My ad in the March issue of AUDIO appears on page 81, first column."

Mr. Steven J. Budowsky, Musicraft, 48 E. Oak St., Chicago, Ill., writes: In regards to the letter from Stephen Siegel in the March issue, (1) Heat buildup is common in the Revox. *(Apparently this is an explanation for the statement by Mr. Siegel that many 10½ inch plastic reels used on his Revox are warped, sometimes severely.—HB.)* (2) Most Revox owners seem to prefer Scotch tape, probably since Revox sets the bias for Scotch 203. Scotch reels seem to be of a little thinner plastic than BASF or Sony reels and are more subject to warping. (3) Revox adapters are available from the factory or at least the main distributor. In Chicago they may be obtained at any of the four Musicraft stores. Hopefully, Sony may have overcome much of the heat buildup by using plastic ventilated hubs on their new 640. Revox take notice! The big motors with metal hubs do get quite warm. The cost of the NAB adapters is $15.00 the pair.

Bias Changing

Q. My questions concern tape head bias adjustment and tape types. I understand that tapes with different characteristics may be used with a given recorder by adjusting the bias level. Can practically any tape be used with any high quality recorder having suitable bias adjustments, or are there definite practical limitations? How serious would a mismatch be? Would frequency response and noise levels be greatly altered? Also, certain tapes are recommended by tape recorder manufacturers for use with their machines. Should I accept such a recommendation, or might it be profitable to experiment with other brands and types? Are all brand-name tapes of comparable quality?—Robert A. Sisk, Boston, Mass.

A. Audio tapes of good quality made by well-known manufacturers tend to be substantially alike in their bias requirements for a given frequency response and for a given kind of tape (such as low-noise, high output, convential, etc.). Each tape manufacturer keeps informed of what others are doing, and hence there is substantial—though not complete—similarity among various brands with respect to the magnetic characteristics of a given kind of tape. On the other hand, differences do exist, although usually slight, and these may be compensated by adjusting bias of a particular machine for the particular tape to be used with it. The bias adjustment has sufficient range to accommodate all tapes ordinarily used for audio.

Whereas manufacturers used to preset bias to meet the requirements of so-called conventional tape, a number of tape machines now come with bias set for low-noise tape. In the latter event, the machine probably also provides somewhat different record equalization and different record drive current than in the case of conventional tape (more bias, more audio drive, and less treble boost).

All in all, it is wise to follow the recommendation of the tape manufacturer with respect to the tape(s) to be used with his machine. On the other hand, it does no harm to experiment with other brands.

Apart from magnetic characteristics, there tend to be some differences among various brands of high-quality tape with respect to such things as dropouts, lubrication, squeal, etc. The tape that works best with one machine may not do so with another.

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

Low VU Readings

Q. I own a Zenith stereo phonograph with an AM-FM tuner, Model X940. I recently purchased a TEAC A-4010S stereo tape deck to operate in conjunction with the Zenith. When recording a tape, the instructions are to regulate the line input of the tape deck so as to have a zero reading on both VU meters on the loudest sounds. To reach zero, the input must be turned to maximum or near maximum, depending on the source (records, FM, etc.) When playing back this tape, the instructions are to regulate the playback control of the tape deck so as to have a zero reading on both VU meters at the loudest point. Even with the playback control at maximum, the level will only go to -4 on the VU meters. The following data are pertinent. Tape deck: input (line)—100,000 ohms, 0.14 v. minimum; output—1 volt for a load impedance of 10,000 ohms or more. Zenith amplifier: input—inpedance of 1 megohm per circuit; output—impedance of 15K ohms per circuit. My questions are: (1) How much will a low reading on the VU meters during playback alter the quality of the taped recordings? (2) Why is the reading on the VU meter low on playback? (3) How can I, if necessary, correct the low readings?—Edward F. Sobota, Latrobe, Pa.

A. (1) A moderately low VU reading in playback should not alter the quality of the sound. However, if the playback signal is unduly low, then noise of the following amplifier stage may significantly reduce the signal to noise ratio. (2) The VU meter may be miscalibrated, so that you are recording too low a signal on the tape. Correspondingly, you get a low signal in playback. Another possibility is insufficient gain in the playback amplifier. (3) Unless you are equipped with technical knowledge and instruments such as a signal generator, VTVM, and harmonic distortion meter, the situation should be checked and corrected (if possible) by a competent technician. Find out from your audio dealer who is the nearest authorized service agency.

Splitting Tape

Q. I recently acquired a quantity of instrumentation tape. Can this be split and used for regular audio recording purposes?—Ron Kirsch, Redwood City, Calif.

A. I cannot advise you on how to split tape except to say that it must be done with great precision and care to avoid cupping, curling, skewing (because the tape is too narrow), sticking (because the tape is too wide), etc. And I cannot say whether instrumentation tape is apt to be adequate for audio purposes. There is a chance it may not be, unless you make appropriate bias changes, and perhaps changes in equalization and signal drive current. Various kinds of tape are made for specific purposes, and hence when a tape made for one purpose is employed for another purpose, there is no guarantee of satisfactory results, however good the tape is for the original purpose.

What's New in Audio

KLH speakers

The Model Six by KLH is now available in three new variations known as the Decorator Series, which features grilles of either walnut or antique brass. Shown are the Model 6 DW with walnut grille, the Model 6 DS with antique brass screen, and the Model 6 DM with antique brass mesh. Prices: M-6 DW, $144.95, M-6 DS and M-6 DM, $149.95.

Check No. 40 on Reader Service Card

Fisher turntables

A new line of three automatic turntables has been announced by Fisher, including the Models 502, 402, and 302. The three-speed turntables incorporate four-pole induction type motors, variable speed controls, anti-skating compensation, cue control, and record-size sensing device. Prices: 502, $149.95; 402, $129.95, and 302, $99.95.

Check No. 41 on Reader Service Card

Quadio CH-702 cartridge player

This unit will play both four-channel, eight-track stereo cartridges and standard two-channel, eight-track cartridges. It requires nothing more for operation than four speakers. The amplifier section is said to have a 20 watt rms output into four ohm loads, while signal-to-noise ratio is specified at 50 dB, wow and flutter at less than 0.35 percent at 3 kHz. Price, $169.95.

Check No. 42 on Reader Service Card

Calectro printed circuit kit

This kit contains all the materials needed to make four or more etched circuit boards: resist lacquer, etching solution, copper-clad printed circuit boards, resist strips and circles, etc. Step-by-step instructions are easy to follow, allowing fabrication of boards for a variety of projects. No special skills or equipment are needed, and the only tools required are those commonly found in the home workshop. Price, $3.95. **Check No. 39 on Reader Service Card**

The Belle Klipsch speaker

This speaker system is a domestic version of the Klipsch La Scala theater speaker, incorporating a shorter mid-range horn and new overall dimensions –34" high by 30" wide by 19" deep. Frequency range is specified as 45 to 17,500 Hz ± 3 dB. Impedance: 16 ohms. Power requirements are 30 watts for the average room, and capacity is 100 watts rms. Price: $815.00.

Check No. 44 on Reader Service Card

Literature

Pickering and Co., Inc. offers three brochures designed to help in matching cartridges to record players. The literature gives specifications on the firm's line of cartridges, explanations of the company's dynamic coupling factor for rating playback systems, and a chart showing the proper cartridge-record player combinations.

Check No. 45 on Reader Service Card

W. Schwann, Inc. has released the Schwann Children's Record Guide, listing more than 1200 LP recordings on 100 labels. The Guide is revised to include the latest releases for 1971. It may be obtained for 35¢ at record shops locally or it can be ordered directly from the publisher at 35¢ postpaid: W. Schwann, Inc., 137 Newbury St., Boston, Mass. 02116

Check No. 46 on Reader Service Card

RCA Corp. offers its latest Linear Integrated Circuits Manual, IC-42, which has been extensively revised and expanded to cover the latest innovations in technology and provide broader information on fabrication, design, and applications.

Check No. 47 on Reader Service Card

AKG has released a booklet describing its CMS modular condenser microphone system, which is based on the C-451E preamplifier. Technical data includes a schematic of the preamp, together with specifications, directional patterns, and sensitivity curves for each microphone capsule. **Check No. 48 on Reader Service Card**

Eico Electronic Instrument Co., Inc. has published its 25th anniversary flyer, a 16-page brochure which details Cortina stereo equipment, Eico test equipment, kits, automotive electronics, color organs, and environmental lighting systems. **Check No. 49 on Reader Service Card**

Electro-Voice offers Guide to Communications Microphones, a 32-page booklet which discusses types and characteristics of communications microphones and gives suggestions for various uses from the E-V line.

Check No. 50 on Reader Service Card

General Electric is offering a 252-page Electronics Experimenters Circuit Manual, ETRM-3960A, which contains 44 projects–3 audio, 10 automotive and marine, 5 game and hobby, 16 for home, farm and camp, and 10 workshop ideas. Price: $2.00 from General Electric, Dept. A, 3800 N. Milwaukee Ave., Chicago, Ill. 60641.

BEHIND THE SCENES

Model 320
Dolby noise reduction processor.

BERT WHYTE

YEARS AGO, back in the monophonic era of audio, we used to receive special FM broadcasts of astonishingly high quality. These were the "labor of love" transmissions arranged by the late lamented Major Edwin Armstrong. For example, he would set up a *live* pickup of the U.S. Navy Band or the Washington National Symphony in Constitution Hall in Washington, *personally pay* for 15,000-Hertz equalized lines to his fabulous transmitter towering high above the Palisades at Alpine, New Jersey. Those of us "in the know" received the broadcasts on an REL tuner (the Rolls-Royce of tuners in those days) and we had special "black boxes" which enabled us to use a 50 Watt McIntosh amplifier as a recording amplifier in conjunction with our Magnecord or Ampex tape recorders for "off-the-air" recording. The high quality of these recordings made people flip! In terms of wide frequency response and signal-to-noise ratio they were miles ahead of most other types of recording. Of course the best sound was to be realized by listening to the broadcasts directly, because the signal-to-noise ratio was superior to what we could obtain from the tape recorders of that time.

In the ensuing years, even the regular commercial mono FM transmissions were blessed with a good signal-to-noise ratio, and the medium, along with much audiophile "off-the-air" recording, flourished. With the advent of FM stereo multiplex, one could not deny the obvious attractions of stereo, but the price we had to pay for it was in terms of greatly degraded signal-to-noise ratio. It is sad to note, in retrospect, that had the FCC chosen the Crosby system of stereo multiplexing instead of the G.E./Zenith system, we would now be enjoying our stereo FM with an approximate 16 dB better signal-to-noise ratio . . . and that is a helluva lot of decibels!

To compound the problem, the G.E./Zenith system permitted the use of a second subcarrier based at 67 kHz, to broadcast music to stores, restaurants, etc. While regular stereo tuners do not receive this extra channel, it has been noted that if a tuner has inefficient low pass filtering between the detector output and the stereo multiplex decoder input, interference between the stereo subcarrier and the "storecasting" information will result as a kind of high frequency "chatter." As a result of the noise problems of stereo FM and the gradual deterioration of the quality of programming of many FM stations, most of the advanced audiophiles and audio professionals that I know do very little listening to stereo FM, and when they do, it is merely for background music. As for their recording "off-the-air," this is a practically nonexistent activity. Even the more casual, less discriminating listener is aware of the noise problems, and those who are somewhat more knowledgeable are

aware that the noise is a limiting factor in the size of the area the transmitter can cover with so-called "satisfactory reception." In sum, as long as we have stereo FM with poor signal-to-noise ratio, the potential of this medium for really high quality sound will never be realized. It is obvious that at this stage we cannot change from the G.E./Zenith system to another with superior noise characteristics. So are we doomed to live with this millstone of noise around our necks? Happily, the answer is . . . no!

Not too surprisingly, our rescuer is Dr. Ray Dolby and his noise reduction system. On March 24th in New York, the hi-fi press were given a "closed circuit" demonstration of a stereo FM transmission utilizing the Dolby B Type noise reduction system. The following day in Chicago, before the assembled members of the National Association of FM Broadcasters, the demonstration was repeated. In each instance there was very favorable reaction to the idea and a lot of excitement was generated. The use of the Dolby B Type noise reduction system in stereo FM broadcasting stems from the fact that many of the parameters of magnetic recording are similar to those of FM transmission. Reduced to the most basic terms, signals are boosted 10 dB by a Dolby 320 B-Type noise reduction unit before transmission, and then attenuated 10 dB in the listener's home, through a typical Dolby B-Type unit such as the Advent 100 or 101. The net result is of course, a 10 dB improvement in the signal-to-noise ratio of the FM transmission. As we shall see, this improvement in noise figures has numerous ramifications for both the listener and the broadcaster.

As you know by this time, the Dolby System works only on low-level signals with thresholds as low as minus 40 dB. Using the masking effect of the ear, high level signals are left essentially unchanged and pass right through the Dolby unit. In the Dolby B-Type system is one band, instead of the four in the professional A301 unit, and this band operates on the high frequency portion of the spectrum, which we hear as hiss. Because the high level characteristics are unchanged, no precautions are necessary to allow for the high frequency pre-emphasis techniques used in FM transmission. At a 25 per cent modulation level the transmit output is still less than plus 1 dB at 15kHz referred to 400Hz, thus meeting FCC specifications for transmitter frequency response. The compatibility aspects are the same as applied to Dolbyized cassettes. In other words, if a listener is not equipped with a B-Type unit for noise reduction, he will hear the FM signals as slightly "brighter" than usual. In many instances with less expensive FM receivers . . . most certainly with "table model" sets, the added brightness may be preferred. With higher quality receivers, a slight reduction of high frequency response, using the treble control, will suffice to control brightness. As the Dolby engineers point out . . . in areas of low field strength, undecoded B-Type broadcasts give increased intelligibility, since low level information is raised above receiver noise.

The Dolby people are now using the terminology of "coding" for the boost function, and "decoding" for the attenuate function in noise reduction. As in magnetic recording with the Dolby B-Type unit, Dolbyized FM broadcasting requires calibration between the encoder at the transmitter and decoder in the home. Because of the similarities between FM broadcasting and magnetic tape recording, the Dolby B-Type tape reference standards can be used for calibration. You may recall that the "Dolby Level" is the same as the Ampex level of 18.5 mM*/mm for open reel recordings. The Dolby engineers are recommending that a Dolby Level of 50 percent modulation be adopted for FM transmissions. In practice, a station would transmit a short tone (400Hz) at this level which would enable listeners to adjust the calibration control on their Dolby units for proper decoding. That is really all there is to the business of setting up for reception of Dolbyized FM in the home.

As to hardware . . . the present Advent B-Type units will work equally as well with the FM as they do with magnetic recording. Dolby has signed agreements with four manufacturers in Japan, among them Kenwood and Hitachi, for incorporating B-Type circuitry in receivers. There are also going to be new models of the "black box" type which can be used with cassette, open reel or FM. You can look for a playback only B-Type unit, incorporating 19 and 38 kHz filters for use with Dolbyized FM. Such units may sell for as little as $50 to $60 at the consumer level. These units may be quite significant because you can use a standard tape machine to record Dolby FM "off-the-air," and then decode or restore the signals for the noise reduction through these playback only units. As for the transmission end, the same Dolby 320 noise reduction unit that is used to produce B-Type tape masters, can be used with equal facility to encode broadcasts.

What can a 10 dB reduction in noise do for the listener? Dolby tests show that S/N relative to 40 percent modulation at a field strength of 1 millivolt for example, is better than -72 dB. At a field strength of only 100 microvolts the S/N is -60 dB. For listeners in the "close-in" areas this means FM reception with inaudible hiss. The noise reduction means that the power of a 50,000 watt ERP station is in effect increased to 500,000 watts. A tuner of 10 microvolts sensitivity for 20 dB of quieting, will achieve that quieting at 3 microvolts. Listeners who are now located in what are called "fringe areas," with marginally acceptable reception, would enjoy better reception by a factor of 3. For the station, the 10 dB of noise reduction means an extention of area coverage three times greater than formerly possible. This means increased revenues for the station since they can deliver more listeners to their advertisers. The noise reduction can be equated in other ways . . . simpler antenna systems for example, or a reduction in transmitter power.

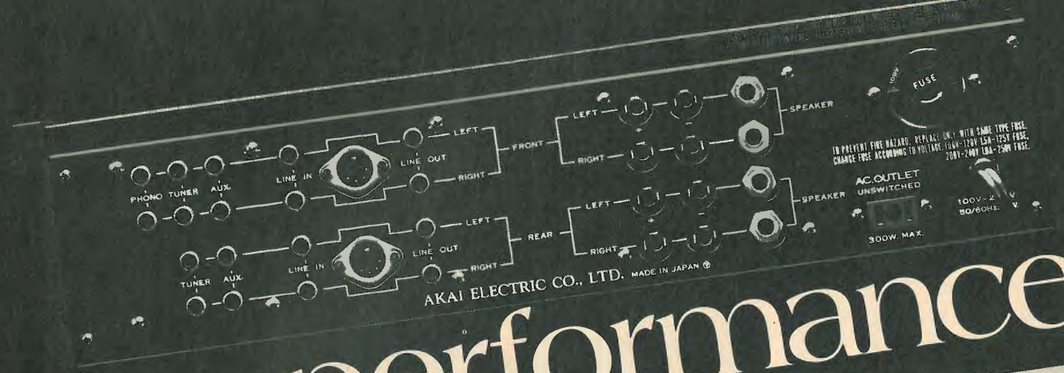
Okay, let us assume we will have Dolbyized FM broadcasts. The first thing that comes to mind is that now we have the somewhat ironic situation wherein the S/N of the transmission is far quieter than the program material. This suggests that since we have this fabulous S/N, it is time for a concerted drive to get our symphony orchestras on the air for *live* broadcasts. It is time for the Metropolitan Opera people to give up on their long time ban on stereo broadcasting. A great step in the direction toward superior program material is a joint undertaking between Dolby and London/Decca which will make available to FM stations a package of recent Decca master Dolby A-Type tape recordings. The cost of these is expected to be quite nominal. These master tapes broadcast and received using the Dolby B system will give listeners super quality sound impossible to achieve at present. Presumably other recording companies would follow suit in this manner and we could look for a general upgrading of program material.

When will Dolbyized FM come into being? Stations could actually be using this system by the time you read this. There are really no barriers involved. The hardware for transmitting and receiving is not a factor. Probably the more venturesome stations like those who are now transmitting the EV four-channel stuff would be the first to take the plunge. Just think . . . Dolbyized four-channel stereo FM transmissions! Gadzooks! I can hardly wait!

There was an accidental transposition of words in my April column. The sentence should properly have read, "This gives a value of time delay on the order of 25 milliseconds and the output is feeding *information direct* to the rear channels." Æ

*milliMaxwells

high performance



up to the latest 4-channel system

...designed for audiophiles

AA-6300 | **AA-6600/AA-8500** | **SW-170A**

AKAI offers amplifiers and speakers of uncompromising standards... up to the latest 4-channel system. If you're planning a high performance audio system, it'll be worth more than your time to look into AKAI's amplifiers and speakers designed for audiophiles.

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Dear Editor,

BUCHAREST INSTITUTE

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TRANSPET RESEARCH DEPARTMENT

Dear Sir:

Regarding the article appearing in the April issue of your magazine, I would like to point out that the device under discussion was merely an early prototype of an improved transpet device. The new device is completely solid-state with a design configuration similar to the MOS-FET semiconductor, thereby eliminating the krypton gas atmosphere. One of the problems of the early prototype was the lack of portability due to the antenna required for its operation. The new device incorporates the rhodium directly into the case of the unit eliminating the need for an antenna. Secondly, instead of attempting to dissipate the heat created during operation, the heat is harnessed through internal thermocouples to provide additional energy for the unit.

The American agent is Mr. Thomas B. Hayes of Teaneck, N.J.

H. Cramfosedi
Asst. to Dr. I Lirpa

We are pleased to hear about the timely modifications to the transpet device. We understand that a consumer organization had one of the original models for test and one of the engineers had the misfortune to drop the device which, of course, shattered. It was some time after that it was noted that krypton gas, in the presence of air and the catalyst rhodium, acts as a powerful aphrodisiac. The consequences were disastrous, and Dr. Lirpa is being sued by the organization for an astronomical sum.—Ed.

Disc-ordant Rock

Dear Sir:

I found one of Mr. Coane's statements in his letter in your January issue rather questionable. He said (concerning rock music), "off-center pressings don't hurt the sound of music that is purposely distorted *before* recording."

In the first place, basic alternating current theory tells one that frequency modulation, produced by off-center discs, is entirely different from amplitude distortion. Whether or not rock music is affected by variations in pitch (I claim *all* music is) has nothing to do with its distortion content.

Secondly, it is only electric guitars whose waveform is distorted. The remaining vocals, percussion, and acoustic guitars require high fidelity equipment for realistic reproduction.

I am continually irritated by implications that rock music is not worthy of high fidelity reproduction. I realize that rock music cannot equal the frequency or dynamic range of classical music, but this is characteristic of rock in general, not just of modern groups. Most rock albums do sound significantly more realistic when reproduced by high fidelity equipment.

Jon Warden
Ames, Iowa

Calling All Skunks

Dear Sir:

Your magazine continues to print opinions contrary to fact.

For one who has resolved not to continue a squirting contest with a skunk, it takes a lot of goading to cause him to rise to further combat.

"Hollowness" in a loudspeaker output is due simply to the amplitude response curve shape, in the form of a "hump" in the mid frequencies from about 400 to 2000 Hz. Modulation distortion does not play any part in this effect as far as I know.

There is some doubt being expressed as to the existence of modulation distortion. Let the doubters take 2 oscillators, and to be absolutely "pure," use 2 separate power amplifiers, and radiate those 2 frequencies from the same diaphragm. If a single diaphragm radiates 50 and 500, and the sound levels are brought up to "realistic" levels—say 100 dB at two feet, you will hear the upper frequency flutter. This is a combination of frequency modulation distortion (FMD) and amplitude modulation distortion (AMD). In our measurements we frequently find AMD exceeds FMD by as much as 10 dB.

And if there is any question about "realistic" sound levels, take a sound level meter to a concert. If a symphony orchestra produces a full *ffff*, the needle will go to 105 and you can add at least 5 dB to that for peaks that the needle can't follow.

I have braved the uncomplimentary stares of nearby listeners as I opened up the sound level meter, but I got the numbers. Just like Massa says, it takes about 114 dB for the peaks of "realistic reproduction of music."

Paul W. Klipsch
Klipsch & Assoc., Inc.
Hope, Ark.

Would any skunks care to reply?—Ed.

Editor's Review

THE FEDERAL Trade Commission has been holding Public Hearings in connection with the new proposed trade regulations concerning amplifiers. Or, to be strictly correct, Power Output of Amplifiers for Home Entertainment Products. The EIA statement was read by W. E. Boss (V.P. of Sylvania), who said, "The difficulties involved are made more complex by the fact that we are selling to two greatly different groups." He went on to say that "one group has very little technical knowledge and the other is very much concerned with performance details. . . . The new EIA standard, RS 234C, was devised to eliminate confusion and deception in advertising." The salient features of this standard are: A) Removal of power bandwidth specifications, and B) Non-disclosure of distortion measurements *unless they are above five per cent.* It was emphasized that all the relevant bandwidth and distortion figures could be quoted if so desired. It was claimed that the first proposal will discourage a frequency "numbers game" and the second was based on the premise that "many of our customers can perceive little difference in sound quality when the distortion is reduced from five per cent to one per cent." Both these propositions were challenged by Walter Goodman, representing the IHF; Morley Kahn, Dynaco, and Harold Weinstein, Lafayette. Statements agreeing with the original Federal Trade Commission's proposals were sent in by KLH, AR, and others. The EIA specifications are supported by Sylvania, RCA, Magnavox, GE, Zenith, Fisher, Motorola, Admiral, et al. The hearings have now finished, and it is anybody's guess what the outcome will be. It was noted with some amusement that the Federal attorney thought the EIA specifications could mean, in some respects, that a poor amplifier could receive the same rating as a good one! The remark was not seriously contested. . . . One interesting point *did* emerge—all parties agreed that the rms power figure is preferable to a Music Power or 1 dB rating. And so we make progress. . . .

Big news recently is the Dolby system for FM broadcasting stations. As it can increase coverage, and thereby step up advertising revenue, its adoption by most stations is a foregone conclusion and Ray Dolby must be well on the way to being a hi-fi millionaire! Details on the system—which does indeed radically improve signal-to-noise—will be found in Bert Whyte's "Behind the Scenes" article on page 10.

Events

Members of the Beverly Hills "CTL Forum on Audio," a group of college students interested in electronics, music, and professional recording, will hold a three-part forum on June 20 at 8:00 p.m. at the Jans Restaurant, 4202 Beverly Hills Blvd., Los Angeles, Calif. Representatives from the professional field will hold a discussion on the state of the art of equipment used in Hollywood studios and demonstrations will be made.

Brigham Young University is holding its fifth annual audio and recording seminar—which will include a quadraphonic recording session with Stan Kenton's band. The seminar will be held from August 9th to the 13th. Details from A. Sigman, Room 242, HRCB, Brigham Young Univ., Provo, Utah 84601.

The Vermont Orchestral Institute will have a special session on the campus of Windham College from June 27 through August 7. Lectures, programs, and demonstrations will be given by well-known artists, authors, and composers, and there will be a special symposium on the state of music and the arts. Complete information can be had from the Secretary, Vermont Orchestral Society, Windham College, Putney, Vermont 05346.

Humor in Translation

From a Japanese trade magazine, "A record player dislike the oscillation from the outside. This is because tracing oscillation of extreme narrow gap with a tapering needle, it must not pick up a mere thing except oscillation. As a very big evil by this, there is a bad influence causing a howling on account of that sounds out of speakers conduct on a record player and they are picked up by a needle point. Generally, speaking, from the operational point and from the meanings of hearing the right and left tones control sections had better be near at hand. But in doing so a record player is put in the place where it is apt to receive the sound pressure from both speakers, so it is difficult to take measure to this problem.

"As a howling countermeasure, it is effective to equip record player with an audio insulator on its bottom . . . for the listening room, it is important that the reflected sounds and absorbed sounds are kept well in condition." Especially for those people with a Bose system, I suppose. But, on the other hand, how many Americans know *any* language apart from their own? The Japanese writer has certainly tried to "take measure to the problem."

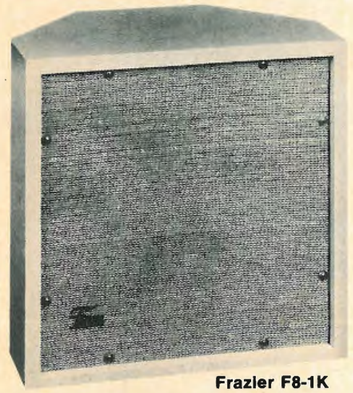
G.W.T.

WITH ALL FORMS of leisure activity moving from indoors to outdoors with the coming of warm weather, it is quite natural to consider the transposition of your stereo system from living room or den to patio or back yard. Happily, the nature of component systems is such that to enjoy "outdoor concerts" you need only provide yourself with a pair of properly placed (and properly designed) loudspeaker systems—the electronics can (and should) stay "at home." Even this minimal effort or addition, however, seems beyond the typical audiophile—as evidenced by the fact that very few speaker systems of high quality are available for outdoor use. This is probably a "chicken and egg" situation—since little demand has been shown for this type of product, few manufacturers are willing to invest in new tools and designs for "outdoor" high fidelity speaker systems.

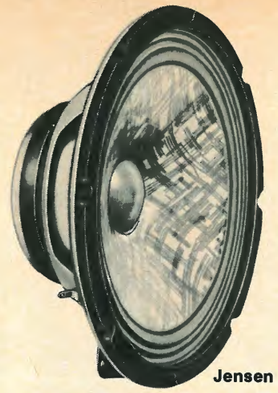
Of course, there is no reason that forbids the moving of your "indoor" speakers to an outdoor location each time you want to enjoy open air listening, but since such speaker systems are not built to withstand rainstorms, high humidity and the other hazards of "outdoor living," this means carting them back and forth every time you want to enjoy outdoor sound. Uneven absorption of moisture by a paper speaker cone will often distort the cone sufficiently to cause a rubbing voice coil. Normally, gaps between voice coil structure and its surrounding magnet assembly are measured in thousandths of an inch and any alteration of the careful centering of the voice coil will, at very least, cause distortion. In extreme cases, the resulting rubbing voice coil will render the speaker useless. While there is no reason why, having installed the necessary runs of speaker cables, you cannot move your existing speaker systems outdoors each time you wish to listen to them and then return them to their interior location after the listening session, such a chore would discourage most people since today's high fidelity speaker enclosures are not "lightweights."

There are acoustic phenomena associated with outdoor listening which would discourage the use of "room" speakers outdoors as well. For one thing, outdoor listening involves almost the total elimination of reverberation and its contribution of sonic energy. There are *no walls* to "bounce" some of the sound energy back to you, and all but directly radiated sound is quickly dissipated in every direction, leaving but a fraction of the produced acoustic energy available for you to hear. This fact would tend to preclude the use of

"low efficiency" speaker systems. In instances where 20 watts per channel of amplifier power is enough to drive a low efficiency speaker system to "concert hall" levels indoors, the same speaker system might require 50 or even 100 watts of power (assuming the voice coil could handle that amount of power without burning up) to produce the outdoor sonic equivalent. Since you're not likely to replace the amplifier in your system for the sake of outdoor listening, the logical approach is to consider the purchase of a speaker system which is both high in efficiency and designed specifically for permanent outdoor installation.


Frazier F8-1K

Wiring your speaker lines for outdoor speaker installation involves considerations which are quite different from the almost casual use of "zip cord" or lamp wire for indoor speaker installation. Before making a permanent cable run, therefore, let's consider another acoustic phenomenon associated with outdoor listening. Normally, stereo separation is optimized in an indoor listening area by spacing the speakers between eight and 14 feet apart in typical rooms. The pair of speakers are usually located against a wall which becomes your imaginary "stage" or proscenium arch. In the case of outdoor installations, we have found that overly wide spacing between stereo speaker pairs is not desirable. Even when sitting at distances of up to twenty feet from the sound source, about eight feet of speaker separation is all that was required. Increased separation byond this included angle resulted not only in a so-called "hole in the middle" effect, but in what sounded like two independent program sources, rather than a "wall of sound." Undoubtedly, the lack of a back-up wall and other reverberatory surfaces accounts for this difference. In any event, auditioning the stereo separation effects before running the permanent cables is a good idea and lengths of ordinary


Jensen TX-800

lamp cord can be used for this purpose. For the final installation, different sorts of weather resistant cable will have to be used.

Proper Wiring

While "zip cord" is satisfactory for short, indoor runs to loudspeaker systems, it is not adequate for outdoor use for at least two reasons. Usually, this type of wire is insulated with neoprene or some other rubber-like compound which becomes brittle and will crack with extremely cold temperature or high moisture conditions. In addition, most "zip cord" contains two conductors, each of which is of #20 or #18 gauge stranded wire. If power loss is to be kept at a minimum, such wires are good for only about a 20-foot run between amplifier output terminals and speaker terminals. Remember, a 20-foot run of speaker cable really means 40 feet of current-carrying wire—20 "going" to the speaker and 20 "returning."


E-V Sonocaster 1

More rugged, two-conductor cable, such as Belden #8471 for example, has been found to be ideal for outdoor speaker wiring. This particular cable consists of two #16 gauge conductors, each vinyl-jacketed, plus a chrome colored vinyl overall jacket which surrounds both conductors. It has been suggested by some that 300- or 75-ohm coaxial lead, such as that used for FM or TV antenna lead-in cable, might make a good speaker cable, since it is certainly weatherproof. Unfortunately, the gauge of such cables is usually only #20 or even less. It is therefore not suitable for carrying the high currents associated with power amplifiers.

Unless you can afford to properly bury the chosen cable by passing it through suitable non-corroding lead or copper tubing, it is best to run your speaker lines overhead, high above the ground as inconspicuously as possible. It is all right to run both dual-conductor cables of a stereo pair together, physically, even twisting them together


University WLC

for extra strength, since the low impedance of the circuit will not permit occurrence of significant cross-talk between channels. Direct runs from amplifier to speaker systems will be satisfactory for distances up to about 50 or 60 feet. At a distance of 60 feet, the total wire run, as noted, is really 120 feet per channel. The resistance of #16 gauge wire over such a length is approximately 0.5 ohms. When feeding 25 watts of power to an 8-ohm loudspeaker, the current flow through the speaker voice coil will be approximately 1.76 amperes ($I = \sqrt{W/R}$, where I is current in amperes, W is power in watts and R is resistance in ohms). This same 1.76 amperes, flowing through the 0.5 ohms of resistance, will dissipate approximately 1.55 watts in the cable itself ($W = I^2R$, where W is power in watts, I is current in amperes and R is the resistance of the cable.) This represents a fairly high percentage of total power developed by the amplifier and so, for greater distances than 60 feet or for multiple system installations such as might be required to service an extensive lawn area, the use of the "70.7 volt constant voltage system" should be considered. This system is quite popular in public address system installation but may be unfamiliar to high fidelity equipment users, so we will describe its principles briefly.

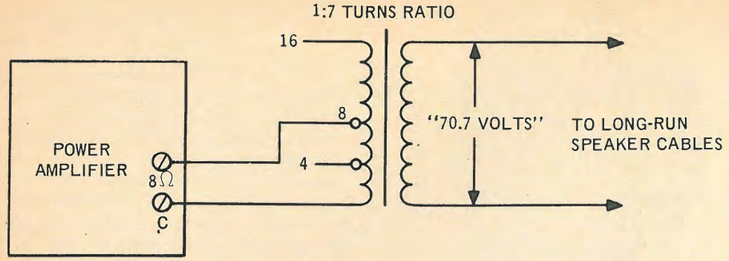
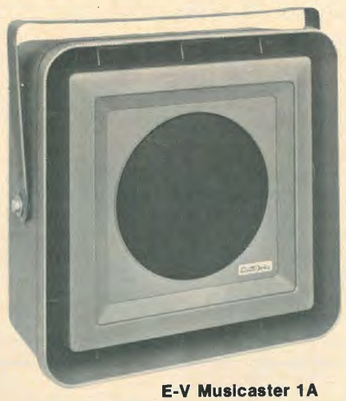


Fig. 1—A "70.7 volt line" audio matching transformer permits low-loss transmission of audio power over long cable lengths.

Constant Voltage Technique

Just about every good high fidelity power amplifier on the market today (be it tube type or solid state) employs a great deal of negative feedback from the output back to an earlier low-level amplifying stage. While the primary purpose of such feedback is to lower overall harmonic distortion, the application of such a large amount of feedback results in an amplifier whose output terminals look like a "constant voltage" source. This does *not* mean that the audio voltage appearing at the output terminals is independent of input audio voltage, of course. What it does mean is that with a given input voltage (the audio signal from the program source), the voltage at the output terminals will remain essentially constant over a wide range of *output load impedances,* ranging all the way from open-circuit to perhaps 4 ohms or less. Using techniques similar to those used by power companies to distribute electrical energy, audio engineers have developed a technique whereby the audio output of any amplifier is arbitrarily stepped up to 70.7 volts rms by means of a step-up transformer. This 70.7 volt figure applies regardless of the power rating of the amplifier, as you will see shortly. As an example, suppose we are dealing with an amplifier that has a power capability of 25 watts when driving a 4-ohm load. The voltage across that load must be 10 volts rms, since power output (W) equals the square of the voltage (100) divided by the load impedance (4 ohms). To use the "70.7 volt distribution" system, a transformer would be connected at the output which would have a turns ratio of approximately 7:1, as shown in Fig. 1. At full power output, then, the voltage appearing at the secondary of the transformer will be the required 70.7 volts. Now, to develop 25 watts of power when the voltage is 70.7 volts requires only about 0.35 amperes of current (I = W/E) as opposed to the 1.76 amperes required in the previous example. In that example, then, had we used the "70.7 volt" system, the power drop along the 60-foot speaker cable having a total "loop" resistance of 0.5 ohms would be only 0.016 watts compared with the 1.55 watts dissipated in the speaker lines in the previous example.

University MLC



E-V Musicaster 1A

While it is easier to think of the system as a voltage step-up approach, the fact is that the transformers used in the system change the output impedance as well and so, at the end of the line a step-down transformer must be used to match the voice coil of the loudspeaker. These transformers, too, are labelled only in terms of power rather than impedance. They are equipped with multiple secondary taps to enable you to choose exactly the amount of maximum power you want fed to a given speaker (with 70.7 volts rms understood to be the maximum driving potential). In multiple speaker installations, the system becomes extremely simple to use. All speaker lines emanate from the secondary of the step-up transformer at the amplifier end of the system. At each speaker termination point, the converse step-down transformer is used and the power desired from each speaker is determined merely by connecting the given speaker to the appropriately labelled secondary taps. An example of a 4-speaker hook up using this system is shown in the diagram of Fig. 2. Note that the *total* power to all the speakers is set at 50 watts, the maximum power output capability of the amplifier in use. The system is completely analogous to electrical power distribution in your home, in that you can plug in many appliances in your various electrical outlets. The voltage available to each is the usual 110-120 volts a.c., but the power drawn by each will be determined by its impedance or resistance. The number of appliances is limited by the rating of your house fuse or circuit breaker (and the limits of the utility companies of late), whereas the number of speakers you can use with a given system will still be limited by the power capability of your audio amplifier. Primary impedance of each speaker step-down transformer may be calculated from the formula Z = 5000 ÷ P, where Z

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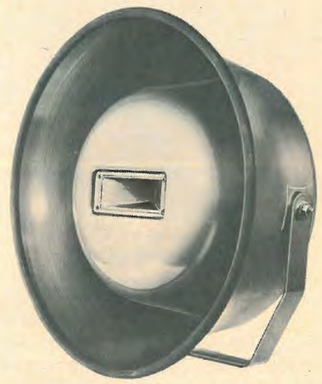


Jensen HF-100

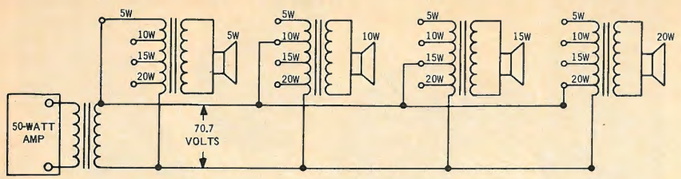


Fig. 2—Use of the 70.7 volt system to feed four speakers of different power levels.

is impedance in ohms and P is power desired at a given speaker. Secondary impedance should of course match speaker impedance.

A suitable step-up transformer to use at the amplifier end might be Triad's model #S-44-Z, available from electronic parts distributors. It will work well with amplifiers having power outputs from about 10 to 50 watts per channel. For stereo applications, of course, one such transformer is needed for each channel. The 4, 8 or 16 ohms winding is connected to your speaker output terminals on the amplifier while the other winding feeds the long speaker lines. A suitable transformer for the far (speaker) ends of the lines might be Triad's Model #S-71-Z which has several taps enabling you to select the power output desired at each speaker location. Taps available on this particular transformer include 10 watts, 5 watts, 2.5 watts and 1.25 watts.

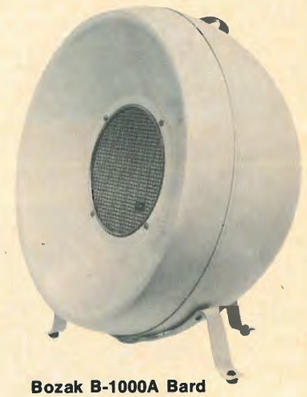
In using 70.7 volt matching transformers for long-run, multiple speaker installations in outdoor stereo speaker systems, pay particular attention to phasing of stereo pairs of loudspeakers. It is fairly easy to inadvertently reverse phase of one speaker because of the presence of the matching transformers. Just as with indoor phasing checks, listen to any source of monophonic programming while you stand mid-way between a given outdoor speaker pair. Reverse connections to one of the speakers and choose that connection which results in the best overall bass response and the least "hole in the middle" effect.

Altec 829A

Jensen TXC-84

Speaker Switching

If your amplifier or receiver is equipped with a speaker selector switch and you plan to have only one pair of outdoor speakers you can use the remote speaker terminals of your amplifier for this outdoor pair and switch them on and off directly from the amplifier or receiver. In more complex installations, you may want to add external switching facilities. It is suggested that such switches (and for that matter, any "L-pad" or "T-pad" level controls you might want to add) remain indoors, ahead of the long speaker lines. Few of the commercially available switches or level controls are weatherproofed for outdoor use. If you own solid state equipment, be sure that any switch you choose is of the "break-before-make" or non-shorting type to prevent even momentary short circuits across your speaker terminals while switching from one position to the next. One such non-shorting switch we know of is available from Lafayette Radio as their catalog number 99E01745 and it is suitable for stereo use although it is limited to selecting only one of three possible pairs of speakers at a time.



Bozak B-1000A Bard

Available Outdoor Speakers

In polling a rather long list of high fidelity loudspeaker system manufacturers, we were surprised at how few offer specific models for outdoor use. As with most indoor speaker systems, few really meaningful specifications are provided by the manufacturers other than a general statement as to frequency response range (without any ± dB "bounds"), power handling capacity, voice coil impedance and physical dimensions.

Altec-Lansing, for example, offers their Model 829A "Patio" speaker system which utilizes the Altec 755E wide range speaker capable of handling 20 watts rms of audio power. The driver is housed in an impact-resistant molded cabinet which is basically an infinite baffle design. The impedance of this unit is 8 ohms and the frequency range

(Continued on page 26)

(Continued from page 24)

is stated as being from 60 to 15,000 Hz. A chrome-plated adjustable stand is provided for free-standing installation or wall mounting. This system sells for $82.50.

Bozak's Model B-1000 "Bard" system, another infinite baffle design, sells for $89.50 and features their B-800 speaker system which employs a metal diaphragm with a neoprene coating. This unit too has an impedance of 8 ohms and claims a frequency response of from 50 to 10,000 Hz.

Electro-Voice, Inc. offers two outdoor units, the Sonocaster I at $22.95 and the Musicaster IA at $70. The former unit utilizes an 8" radax coaxial speaker in a molded housing while the latter system uses a 12" radax speaker. Both units will handle 30 watts of power and have an impedance of 8 ohms. Frequency response is 70 to 13,000 Hz, according to the manufacturer.

Utah Electronics offers an 8 inch speaker in a steel enclosure with baked enamel finish at $24.95. The Model HFOD-8 will handle 30 watts of peak power, has an impedance of 8 ohms and a frequency response range of from 35 to 19,000 Hz, according to the manufacturer.

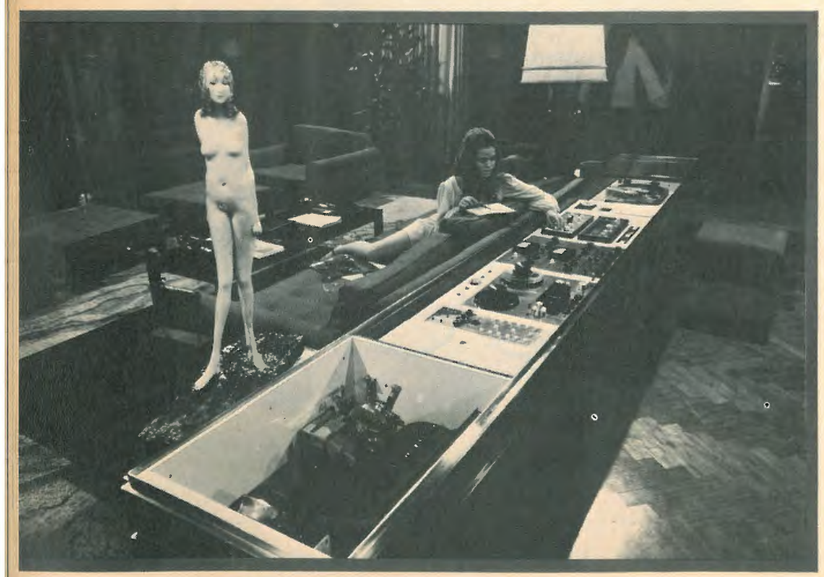
University Sound has three outdoor models in their line. The Model MLC will handle up to 15 watts of music power and is a two-way system. The Model BLC will handle 30 watts of music power and employs a rear horn-loading principle, while the Model WLC will handle up to 50 watts of music power and features a 1000 Hz L-C crossover network in this two-way system. All three models have an impedance of 8 ohms and boast 120 degree angular dispersion. Frequency response range varies from 150 to 15,000 Hz for the Model MLC to 50 to 15,000 for the Model WLC. Prices range from $45.00 upward.

Some of the larger electronic distributors, such as Lafayette Radio and Allied-Radio Shack show "private brand" outdoor speakers in their catalogs which you may well want to audition, too. In assessing the merits of any outdoor speaker system, attempting to judge the tonal qualities in a dealer's showroom will be a bit difficult since the systems are intended for outdoor use. Even a highly damped (acoustically) room cannot properly approximate open air and most audio showrooms are furnished so as to approximate "living room" listening conditions. Bear in mind, however, that while outdoor concerts never sound quite like concerts performed in acoustically ideal concert halls, the joy of being able to sit outdoors of a summer evening and listening to your favorite recordings or broadcasts via a pair of properly installed weatherproof outdoor speaker systems is likely to off-set whatever sonic imperfections you may detect. Æ

Directory of Outdoor Speakers

Manufacturer	Model	Power Capacity (watts rms)	Frequency Response(Hz)	Impedance (ohms)	Dimensions (inches)	Weight (lbs)	Price	Remarks
Altec-Lansing	829A	20	60-15,000	8	14⅞x17⅞ x12⅞	10½	$82.50	Can be free standing or wall mounted; infinite baffle.
R.T. Bozak	B-1000 (Bard)	15	50-10,000	8	21x18 x12	20	$89.50	Free-standing unit; infinite baffle design.
Electro-Voice	Sonocaster I	15	70-13,000	8	16¾x17 x5⅞	6¾	$25.00	8-in. speaker in portable, free-standing case.
	Musicaster IA	30	80-10,000	8	21½x21½ x8½	29	$70.00	12-in. speaker in portable, free-standing case.
	Musicaster IIA	30	80-16,000	8	21½x21½ x8½	31	$90.00	12-in. coaxial speaker in portable, free-standing case.
Frazier	F8-1K (Patio)	15	50-15,000	8	15⅞x15⅞ x8¾	18	$49.95	Two-way ducted-port system for wall mounting.
Jensen Mfg. Div.	K-950	16	30-18,500	8	8⅛ODx 3¼D	3¾	$30.25	8-in. coaxial (3 in.) speaker for protected outdoor applications; less enclosure.
	TX-800	25	40-10,000	8	8-1/16ODx 3-1/16D	4	$43.75	8-in. speaker meets military specs.; integral glass fiber case optional.
	HF-100A	25	60-15,000	16	24⅜ dia. x11⅜	23	$92.85	Two-way unit with compression tweeter, folded horn woofer; has bracket mount.
	TXC-56	100	100-10,000	8	9⅝x40⅝ x5⅜	33	$150.00	Six 5¼-in. speakers in sound column.
	TXC-84	100	50-10,000	8	13⅛x52⅝ x7¼	54	$177.00	Four 8-in. speakers in sound column.
Quam	8C6PAXTOK	15	50-20,000	8	8¼ODx 3⅛D	2	$12.95	8-in. speaker unit.
University Sound	MLC	10	150-15,000	8	12¾x9⅛ x10⅝	10¾	$75.08	Two-way folded horn system with bracket mount.
	CLC	15	55-14,000	8	22¾ dia. x12¾	13½	$128.15	Rear horn loaded, direct radiator with bracket mount.
	WLC	25	50-15,000	8	33½ dia. x20	63	$362.95	Two-way folded horn system with bracket mount.
Utah Electronics	HFOD-8	15	35-19,000	8	10⅞x10⅞ x5⅜	5	$24.95	Direct radiator in portable case that can be wall mounted.

Hi-Fi at the Playboy Mansion



GEORGE ALTON removes his shoes, turns the knob, pushes open the door, and enters. His feet sink four inches into the immaculate white shag carpeting. He is in the electronics room in the Playboy Mansion in Chicago, the Playboy corporation's chief promotional attraction and entertainment center. As electronics manager, it is Alton's job to ensure that every one of the Mansion's more than 250 pieces of electronic equipment, worth more than $375,000, will function perfectly when Hugh Hefner flips a switch or presses a button. It's a six-day-a-week, 10-hour-per-day job for Alton and he loves it.

Alton crosses the room and stops before an open copy of *TV Guide* lying on a cabinet top. The magazine is open to a review of the seven motion pictures which will be shown on television that day. Three titles are circled in red. Alton pulls three cards from a file and writes the names on separate cards, together with the channel number and the time the film is to be shown. He places the cards in a pile and then turns to the walnut-paneled wall, which is filled with equipment.

At the start of each week, Hefner leaves Alton a copy of *TV Guide* marked to indicate the motion pictures he wants video taped for his personal collection. Once taped, the films are categorized

and then filed to be viewed at Hefner's leisure. There are more than 700 currently stored in the electronics room. One reel of the two-inch Ampex tape will hold up to five hours of video recording.

Hefner's film choices are categorized under 10 general headings: crime and mystery, horror and science-fiction, drama, romance, sports, spy and suspense, war, western, musical, and comedy. The biggest card file is under spy and suspense, the smallest is under romance.

Life magazine has called the Mansion "Hugh Hefner's huge electronic machine." Thanks to Alton's wizardry, the Mansion is the closest thing to a completely electronically controlled environment. A review of equipment inside the house offers a vivid portrait of Hugh Hefner the audiophile.

Fourteen black and white Zenith television sets (19 inch), 20 black and white Panasonic monitors (9 inch), 10 Zenith color sets (23 inch), 2 VR 660C Ampex video tape units, 4 Conrac color monitors (21 inch), 3 Conrac audio video tuners, a 3M dropout compensator, a Grass Valley input video recorder system, a Grass Valley output distribution amplifier, a Tektronix waveform monitor 529, a 535 oscilloscope, 3 Fisher SA 100 amplifiers, 3 Fisher R 200-5 AM-FM tuners, 2 Ampex 354 mike mixers, a Thorens TD 224 turntable-changer, 2 Ortofon cartridges, 247 rolls of video tape, a Seeburg 100-album juke box, 2 Marantz 10B FM tuners, 2 Marantz preamps, 2 McIntosh 275 amplifiers, 2 Garrard Lab 35 mm motion picture projectors, a GPL projection television unit, 7 16 mm motion picture projectors, an A-7 theater sound system, a 12-by-17 foot perforated screen for motion picture viewing, a JBL Paragon speaker system, a Marconi television camera, plus enough assorted high fidelity equipment throughout the 54-room Mansion to stock a hi-fi shop. This list does not include the 18 matched sets of speakers throughout the building nor the five speakers in the ceiling of the Mansion's dining room.

And all of this equipment is in use, some of it 24 hours a day, seven days a week. Much of the corporation's business and social entertaining is done at the Mansion, and electronics often plays an important part at such functions. This may involve a screening of motion picture rushes for Playboy Productions, the playback of a taped interview with a controversial political figure for use in *Playboy* magazine, the playing of tapes for a gathering of friends, the use of recordings for a party, the video taping of a three-hour film, or the closed circuit telecast of a championship fight.

Electronic Nerve Center

Measuring 12-by-18 feet, the electronics room is one of the smallest in the Mansion, but the $250,000 worth of electronic equipment makes the room the most expensively furnished in the Mansion. It is the electronic nerve center of Hefner's residence. Because of Hefner's fascination with motion pictures, the Mansion's video tape equipment was added to the room several years ago under Alton's direction. For the protection of the films and the equipment, the temperature inside the room is kept at 72 degrees and humidity remains between 35 and 45 percent. Alton can regulate the heat and humidity in every Mansion room from a panel in his basement workshop.

Hefner can walk directly into the electronics room by going through a door in his bedroom. From his 8½-foot circular bed Hefner can operate by remote control the Ampex video tape recorder housed in the electronics room. He can also record any TV program in which he is interested, even while he's watching a different channel. A custom-built clock-control unit can be preset to automatically activate the recorder at the prescribed times to tape any number of programs over a 24-hour period.

The components for Hefner's personal stereo system are also housed in the electronics room. The controls for the system are in the headboard of the bed. A Marantz FM-AM tuner, Thorens automatic turntable, Ampex 354 tape recorder, James B. Lansing Graphic Controller preamp, and a Fisher SA 100 amplifier furnish the signal to the four sets of speakers in Hefner's private quarters. The speakers are Universities, as are all of the speakers in Hefner's quarters, with the exception of the seven-foot JBL Paragon system in his study.

The second center of electronic activity in the Mansion is the 15-foot, custom-built console in the main room. This equipment feeds a signal to speakers in the dining room, pool area, the underwater bar, the game room, and, of course, in the main room itself. The underwater bar is below the surface of the Mansion's 11-foot-deep pool and affords those in the bar area a submarine view of the pool through a large glass window forming one wall of the bar.

All speakers in the pool area, underwater bar, and the game room are Universities. In the main room, four Klipsch-type corner-cabinet systems each contain two 12-inch speakers, two tweeters, a midrange speaker, and a crossover unit. All these speakers are Wharfedales.

A small room off the main room houses the Mansion's motion picture equipment, two Century 35 mm projectors mounted on a raised platform. The room is entered through twin oak doors that swing back into the main room, allowing the projectors to shoot ahead to a 12-by-18 perforated screen which comes down from a wall housing at the touch of a button located inside the projection room. An A-7 theater sound system is built into the wall behind the screen.

Roman Bath

The third major center for electronic activity in the Mansion is Hefner's Roman Bath, a two-room spa just below Hefner's third-floor living quarters on the south end of the Mansion. One of the two rooms contains a bed and a wall panel of electronic equipment. The second room contains the Italian marble bath, which is unlike anything this side of Fellini. On a headboard control panel above Hefner's bed are potentiometers and switches which controls lights, regulate the temperature of the water mattress on the bed, and control the room's television and stereo units, which Alton built into a walnut wall panel directly across from the bed. The components are a Fisher 500 AM-FM receiver, a Cranwood tape unit, and a 23-inch Zenith color television. The speakers are by University. Alton also designed and built a wall panel control center from which Hefner can regulate the lighting around the bath, the water temperature, and the water level of the 38-inch-deep bath.

Joining Playboy

Alton was employed by a Chicago music company in 1949 when he made a service call to Playboy's first offices at 232 East Ohio. Hefner, who then maintained his living quarters in the offices, had a hi-fi set (Ampex tape recorder, Garrard record changer, McIntosh amp, Knight pre-amp) which was giving him trouble.

As Playboy continued its growth, so did Hefner's electronic world. Alton's service calls to Playboy became more and more frequent until he no longer checked in at the music company in the morning but went directly to Playboy and spent the day there.

While he was on the payroll of the music company, he supervised the installation of the Mansion's master TV hookup (the antenna is atop a 440 story building half a mile away), and the installation of the console unit in the main room.

In 1963 Hefner offered Alton a job after discovering he was not on the Playboy payroll.

"He always called me his 'hi-fi guy' and automatically assumed that I was employed by Playboy. In February of 1963, he told me that he had just learned that I was not working for him. He saw me nearly every day and took it for granted I was one of his employees," Alton recalls.

A snag developed, however, when Alton's wife, Antoinette, objected to her husband working for Playboy. As a result, Alton refused Hefner's offer. Hefner, however, was not to be denied. He invited Alton and his wife to the Mansion for dinner. Then he applied his charm.

"I don't know what he said to Toni, but he talked to her for about 30 minutes before we left," Alton says. "On the way home she said I should take the job. To this day neither she nor Mr. Hefner will tell me what they talked about."

Alton is not listed as an executive on any Playboy organization chart, yet he spends more time with Hefner than do more of his key executives. It is not uncommon to find Hefner and Alton sitting on the floor of Hefner's bedroom studying the inner workings of a 16 mm projector or intently discussing the pros and cons of a new piece of electronic equipment.

So complicated is Alton's job that Hefner sent him for two weeks of training at the Ampex corporate facility in Redwood City, California, and for a week of training at the Ampex facility in Elk Grove Village, Illinois. To aid him Playboy also employs a night electrician, a night helper, a day electrician, and two janitors.

In addition to his duties in the Mansion, Alton also supervised the electronic installation in the corporation's DC-9 jet, the Big Bunny. His next major project will be the corporation's recently purchased Playboy Mansion West outside of Los Angeles.

How Much Amplifier Power?

Calculating wattage for sound reinforcement systems

Don Davis*

*Vice President, Marketing, Industrial Products, Altec, a Division of LTV Ling Altec Inc.

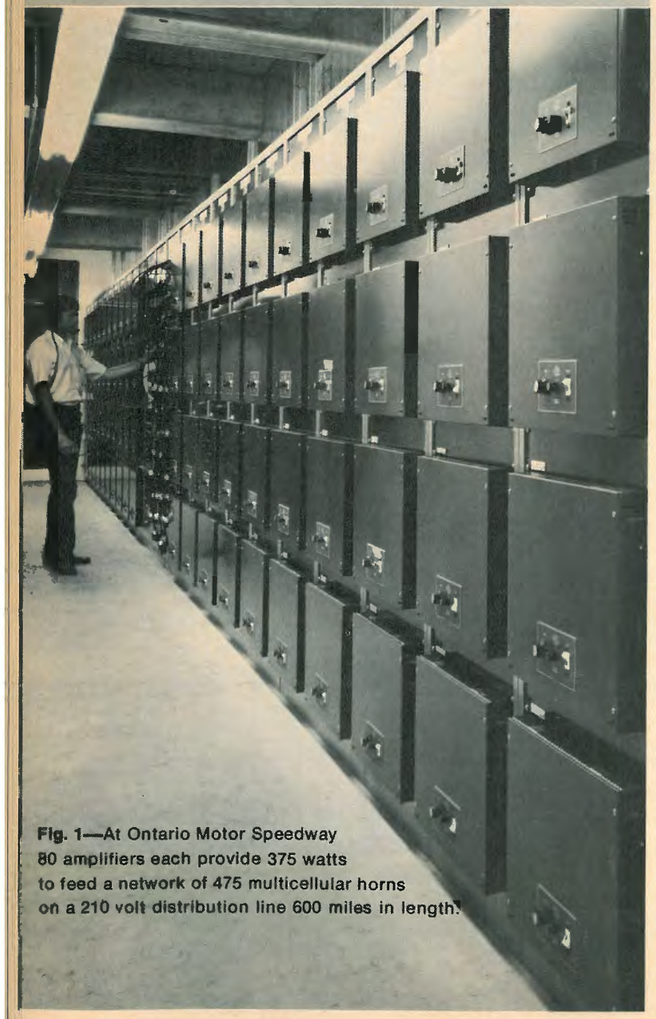


Fig. 1—At Ontario Motor Speedway 80 amplifiers each provide 375 watts to feed a network of 475 multicellular horns on a 210 volt distribution line 600 miles in length.

EDUCATED GUESSWORK has, in the past, many times incorrectly determined how powerful an amplifier to use in a sound reinforcement system. The 1970s has witnessed the advent of super powerful sound systems that often use 5kw in ballrooms and 30 kw at large automobile race tracks. (See Figure 1.) A modern 30,000 watt sound system can't tolerate a 3 dB mistake.

There are many approaches to the calculation of the electrical power required (EPR) of a sound system but the following are the ones that have proven the most successful for the author.

When we have some definite acoustic sound pressure level (SPL) goal in mind at some given distance from a loudspeaker, D_2, we need to know:

1. The sensitivity rating as measured at 4 feet in front of the loudspeaker when the loudspeaker is fed a signal of one electrical watt at its input.

2. The acoustic attenuation between the loudspeaker and the listener.

Once the desired acoustic level has been accurately determined, whether by test, EAD charts (1), etc., the required acoustic level at 4 feet in front of the loudspeaker becomes the desired acoustic level plus the acoustic attenuation from a position four feet in front of the loudspeaker to the listener's position. This acoustic attenuation can be expressed as:

$\Delta D_2 - \Delta 4'$ = acoustic attenuation

Where

ΔD_2 = the D_2 distance in feet inserted as r in the formula:

$$-1\left[10\,\mathrm{Log}_{10}\left[\left(\frac{Q}{4\pi r^2}\right)+\left(\frac{4}{R}\right)\right]\right] = \text{Attenuation}$$

$\Delta 4'$ = the distance 4 feet inserted as r in the formula

$$-1\left[10\,\mathrm{Log}_{10}\left[\left(\frac{Q}{4\pi r^2}\right)+\left(\frac{4}{R}\right)\right]\right] = \text{Attenuation}$$

$R = \frac{S\bar{a}}{1-\bar{a}}$ Where S = total boundary surface area in ft^2

$\bar{a}$ = average absorption coefficient

Q = the directivity factor of the sound source.

It is readily apparent that even when the same loudspeaker is used at the identical distance in two different rooms, the acoustic environment of the room can change drastically the amount of electrical power required to reach a desired acoustic SPL.

To calculate the EPR in watts we can combine these factors into a single formula so that desired acoustic level, acoustic attenuation, and the loudspeaker's sensitivity rating are all accounted for:

$$\mathrm{Antilog}_{10}\left[\frac{\left(\text{Desired level in dB SPL} + 10\text{ dB}\right) + (\Delta D_2 - \Delta 4') - (\text{[L] Effic.})}{10}\right] = \text{EPR in watts}$$

Note that 10 dB has been added to the desired acoustic level to provide for the peak factor that *must* be allowed for the RMS readings taken with a sound level meter. The [L] Effic. is in dB-SPL at 4 feet from one watt as earlier indicated.

A PRACTICAL EXAMPLE

If we had an auditorium with a total boundary surface area of 45,000 square feet and an average absorption coefficient of 0.314 and used a loudspeaker with a Q = 5 and a [L] Effic. = 112 dB SPL where D_2 = 125 feet, we could use the formula given to find the EPR in watts necessary to achieve a desired acoustic level of 95 dB-SPL at the listener's position:

$$\mathrm{Antilog}_{10}\left[(95+10)+(36.58-16.01)^* - (112)\right] = 22.75 \text{ watts}$$

(1) Don Davis, "The Computer In Sound System Design," Audio, August, 1970.

In other words, we require a peak power of 95 dB + 10 dB or 105 dB SPL at the listener's position.

In traveling from a point four feet in front of the loudspeaker out to the listener's position, the sound will attenuate (36.58 - 16.01*) = 20.57 dB. Therefore, we need a total SPL at 4 feet in front of the loudspeaker equal to 105 dB + 20.57 dB which equals 125.57 dB. Since the loudspeaker chosen will produce 112 dB SPL at 4 feet with one watt electrical input, we now require 125.57 - 112 = 13.57 dB ref 1 watt more power. The antilog10 13.57 ÷ 10 = 22.75 watts. (10 log10 (22.75 ÷ 1 = 13.57 dB)

ACOUSTIC GAIN AS A LIMIT

Thus far we have devised a set of calculations for a sound system in which only the power handling capabilities and angular coverage characteristics need to be given consideration. When a microphone is introduced into the same room with the loudspeaker forming a closed loop, the total loop gain will, for all practical purposes, be determined by unity gain. (Phase can enter in appreciably for single frequencies but can be ignored for a speech or music-range system.) Once the sound from the loudspeaker arrives back at the microphone with the same loudness as the sound source does reach unity gain, the system will feedback or howl. The potential gain of the system is, therefore, determined by the acoustic attenuation available between the open microphone and the loudspeaker. While the input level of the sound source at the open microphone does not affect the gain of the system in any way, it does affect the amount of electrical power required to reach unity gain. We can, by substituting the sound source SPL in place of the desired acoustic level, use the same formula as above to find out the EPR to unity gain for any given input stimuli.

EPR TO UNITY GAIN

As an example, let's assume the same room we had before with the same loudspeaker system, but this time we will have the ambient room noise as a sound source and a separation between the loudspeaker and microphone of 30 feet (D_1 = 30 feet). We can then write:

$$\text{Antilog}_{10}\left[\frac{\left(\begin{matrix}\text{Ambient noise}\\ \text{level in dB SPL}\end{matrix} + 10\text{ dB}\right) + (\text{Attenuation}) - (\text{[L] Effic.})}{10}\right] =$$

EPR to achieve unity gain

or

$$\text{Antilog}_{10}\left[\frac{(55) + (31.87 - 16.01) - (112)}{10}\right] = 0.000076913 \text{ watts}$$

to achieve unity gain.

It is apparent that the acoustical separation between the loudspeaker and the microphone in this case is (31.87 - 16.01 = 15.86 dB.)

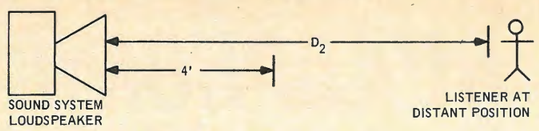
Now, if a performer achieved 95 dB SPL as a program level input at the microphone and the gain of the system were again adjusted to unity gain, the EPR would be:

$$\text{Antilog}_{10}\left[\frac{(95+10) + (31.87 - 16.01) - (112)}{10}\right] = 7.69 \text{ watts}$$

MAXIMUM LEVEL

Suppose that you are writing a specification for a well designed sound system and wish to specify the maximum program level in dB SPL available at some listener position. From the electrical power you have available, our formula is:

*See Appendix



ATTENUATION OF SOUND IN dB FROM 4' IN FRONT OF LOUDSPEAKER TO LISTENER = $\triangle D_2 - \triangle 4'$

WHERE: $\triangle D_2 = -1\left(10\ \text{LOG}_{10}\left[\left(\frac{Q}{4\pi(D_2)^2}\right)+\left(\frac{4}{R}\right)\right]\right)$

$\triangle 4' = -1\left(10\ \text{LOG}_{10}\left[\left(\frac{Q}{4\pi 16}\right)+\left(\frac{4}{R}\right)\right]\right)$

Fig. 2—Calculating D2 attenuation. This chart illustrates how the relative attenuation of 4 feet is subtracted from the D2 distance to gain an actual attenuation figure in dB for the distance from 4 feet in front of the loudspeaker to the listener's ears.

$$10\log_{10}\left(\frac{\text{watts avail.}}{10}\right) - (\Delta D_2 - \Delta 4') + (\text{[L] Effic.}) = \text{dB SPL MAX.}$$

This gives the program level and it is necessary to add 10 dB to this figure to obtain the peak level. Therefore, if we use our same room as before we can now write for a maximum available electrical power of 50 watts:

$$10\log_{10}\left(\frac{50}{10}\right) - (36.36 - 16.01) + (112) = 98.64 \text{ dB SPL}$$

Or for peak level, 108.64 dB SPL.

SUMMARY

These simple formulae have been proven to be quite accurate for the purposes described and the only other allowances necessary in the typical sound system are the power losses in long speaker cable runs and the insertion losses that can be encountered in some 70 volt line transformers. Since these losses are typically given in dB, they can be readily inserted in the formulae directly as required.

Appendix

$$\text{Antilog}_{10}\left[\frac{\left(\begin{matrix}\text{Desired Level}\\ \text{in db SPL}\end{matrix} + 10\right) + (\Delta D_1 - \Delta 4') - (\text{[L] Eff.})}{10}\right] = \text{EPR watts}$$

$$\text{Antilog}_{10}\left[\frac{\left(\begin{matrix}\text{Level at mic.}\\ \text{in dB SPL}\end{matrix} + 10\right) + (\Delta D_2 - \Delta 4') - (\text{[L] Eff.})}{10}\right] = \text{EPR watts}$$

$$\left(10\ \text{Log}_{10}\frac{\text{watts avail.}}{10}\right) - (\Delta D_2 - \Delta 4') + (\text{[L] Eff.}) = \text{dB SPL}_{\text{Out}}$$

$$-1\left[10\ \text{Log}_{10}\left[\left(\frac{5}{4\pi 15625}\right)+\left(\frac{4}{20597.67}\right)\right]\right] = 36.58$$

$$-1\left[10\ \text{Log}_{10}\left[\left(\frac{5}{4\pi 16}\right)+\left(\frac{4}{20597.67}\right)\right]\right] = 16.01$$

Substituting W = 5, S = 45,000, ā = 0.314, and r = 125 feet in the first equation and 4 feet in the second equation we see the use of the relative attenuation formula from an assumed acoustic center. The difference between the two figures is an absolute value.

The Why and How of Horn Loudspeakers

Part II

Victor Brociner*

JBL 2390 horn with acoustic Lens

AN EXAMPLE of horn speaker performance is worked out below. The horn unit is designed to operate in the frequency range above 500 Hz as part of a powerful two-way theater speaker system.

R_c = 12 ohms

B = 1.9 webers/meter^2

l = 1.75 meter

$B^2 l^2$ = 22 webers^2/meter^4

S_T = 3.14 x 10^{-4} meter^2

S_D = 28.3 x 10^{-4} meter^2

S_D/S_T = 9

R_{MA} = 9 x 28.3 x 10^{-4} x 407
= 10.4 mks mechanical ohms.

The initial efficiency at frequencies for which the moving mass has negligible effect:

$$\eta = \frac{22}{22 + 12 \times 10.4} = 16\%$$

If the mass is .002 Kg, at 500 Hz: $2\pi fm$ = 6 mks mechanical ohms and at 5 kHz: $2\pi fm$ = 60 mks mechanical ohms
For constant-voltage operation, using equation (23):

At 500 Hz: $$\frac{\sqrt{P}}{E} = \frac{1.9 \times 1.75\sqrt{10.4}}{12\sqrt{(10.4 + 22/12)^2 + 6^2}} = .065$$

At 5 kHz: $$\frac{\sqrt{P}}{E} = \frac{1.9 \times 1.75\sqrt{10.4}}{12\sqrt{(10.4 + 22/12)^2 + 60^2}} = .016$$

Response is down 12 dB at 5 kHz. This can be partially compensated by making the compliance of the front air chamber resonate with the moving mass as previously described. These calculations illustrate the fact that careful design is required to enable a horn speaker to span even as little as 3 octaves. The magnetic field is not readily increased greatly over the value used above, in the present state of the art. The radiation resistance at the diaphragm is determined by the diaphragm size and throat size. Increasing the diaphragm size raises the mass, and is the wrong direction to go. Decreasing the throat size helps but lowers the efficiency and can increase distortion, as will be explained later. Reducing the voice coil resistance is not an admissible expedient because it changes the impedance rating of the speaker, which is specified. This leaves reduction of moving mass, which is the means used in the design of tweeters.

*Vice President Engineering, H. H. Scott, Inc.

Front Air Chamber

The front air chamber can be used to advantage to extend high-frequency response. However, with a simple coupling chamber between the diaphragm and the horn throat, interference can occur at the throat between sounds originating at different points on the diaphragm. Figure 11A shows two paths from diaphragm to throat. If the diaphragm is 2 inches in diameter and the horn throat is spaced 0.1 inch from the diaphragm, the distance from diaphragm to throat AB is 0.1 inch while the distance A ' B is 1.0 inch. Sounds arriving along these two paths differ in phase by 180 degrees at 7500 Hz, i.e., they oppose each other.

At other frequencies there are cancellations and reinforcements to various degrees. The frequency response is ragged and drops at high frequencies. Interference is minimized in high-frequency speakers by means of *phasing plugs* which provide equal path lengths from different parts of the diaphragm to the throat. One type of phasing plug is shown in cross-section in Fig. 11B. For good response to 20 kHz, where one-half wavelength is 0.67 inch, phasing plugs must be carefully designed and manufactured with great accuracy. This section of a quality tweeter somewhat resembles a fine watch in the impression it gives of precision.

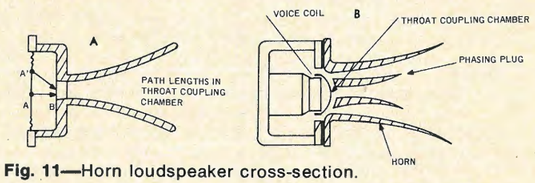


Fig. 11—Horn loudspeaker cross-section.

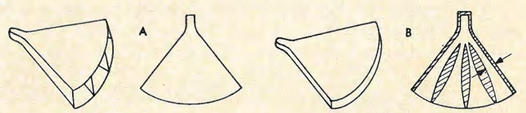


Fig. 12—A, sectoral horn; B, diffraction horn.

High Frequency Distortion

The maximum amplitude of vibration of the diaphragm is inversely proportional to frequency. The formula for the acoustic output of a horn loudspeaker whose diaphragm works into an acoustical resistance is

$$P_A = \frac{7930\, f^2 S_D^2 d^2}{S_T} \qquad (24)$$

where d = maximum excursion, one side.

(Continued on page 38)

(Continued from page 36)

For the theater horn loudspeaker described above to radiate 1 acoustic watt at 500 Hz

$$d = \frac{1}{f S_D}\sqrt{\frac{S_T}{7930}}$$

$$= \frac{1}{500 \times 28.3 \times 10^{-4}}\sqrt{\frac{3.14 \times 10^{-4}}{7930}} = .028 \text{ cm.}$$

This is a very small excursion indeed for a rather high power level, but it must be remembered that the clearance between the diaphragm and the phasing plug is usually very small also, so the excursion must be taken into account. At the lower frequencies the excursion may actually vary the volume of the front air chamber from nearly zero to almost double its normal volume. If high frequencies are present at the same time as the low frequency, the variable acoustic capacitance of the air chamber causes the low frequency to modulate the high frequencies. The amount of distortion depends on the power per unit area at the horn throat. At points along the horn away from the throat the sound intensity decreases and considerably less distortion occurs.

Distortion in high-frequency horn speakers due to nonlinearity of the suspension and of the magnetic system is less than in direct radiators because the diaphragm excursion is lower.

When distortion is referred to, one usually assumes that nonlinear distortion is meant, as evidenced by the generation of harmonics and intermodulation products. There is, however, an additional form of distortion in horn loudspeakers: phase distortion. The phase velocity with which a condition of maximum pressure is propagated through a horn is given by

$$C' = \frac{C}{\sqrt{1 - \frac{m^2 c^2}{16 \pi^2 f^2}}} \qquad (25)$$

Since C varies with frequency, sounds of different frequencies travel through the horn at different speeds. The fundamental and harmonics of a given nonsinusoidal wave are thus displaced in phase; when $f = mc/4\pi$ the phase velocity becomes infinite; all parts of the medium in the horn move in phase as a unit, and the horn no longer functions as a horn.

Folded Horns

Bass horns must have large mouths and a slow rate of taper; consequently they are quite long as well. To reduce the space they occupy they are folded over themselves several times. Wide-range horns for public address installations also have their bulk reduced by folding. Typical PA speakers are folded concentrically to provide relatively long paths of expansion in compact form. These are called re-entrant horns.

There is one difficulty; sound does not go around corners readily except at low frequencies. As the frequency increases, when the dimension across the bend becomes an appreciable fraction of a wavelength, interference occurs in much the same manner as in a horn front air chamber without a phasing plug. The frequency response of a folded horn droops and is ragged in its upper frequency range. The effect can be reduced by minimizing the dimension across the bend and by shaping the outside curve so that it acts as a reflector. In high fidelity reproduction, folded horns are used only for low frequencies.

Directional Patterns

At low frequencies, for which the wavelength is comparable to the mouth diameter, a horn is almost omnidirectional. Its polar pattern is practically the same as that of a direct radiator speaker of the same diameter as the horn mouth. Above this range the horn becomes more directional but less so than a direct radiator of equivalent size, assuming the latter to operate as a perfectly rigid piston. The rate of narrowing of the polar characteristic with increase in frequency is relatively low.

In the frequency range referred to, the size of the horn mouth does not greatly affect the directional pattern, but the flare rate does. Slow rates of flare produce somewhat more directionality. Since the polar pattern depends on both mouth size and flare rate, different directional characteristics can be obtained in two planes at right angles to each other through the horn axis.

Horns used for high fidelity sound reproduction are usually not circular in cross-section because they are designed to provide dissimilar horizontal and vertical distribution. A widely used type of horn is the *sectoral horn.* The two sides are flat planes as seen in Fig. 12, and the horizontal faces are curved in the vertical plane, to provide exponential expansion. Horizontal distribution approximates the angle between the sides; the vertical pattern is determined by the flare rate and mouth size. If the vertical dimension of the mouth is small in comparison with the shortest wavelength radiated, the horn mouth tends to act like a small horizontal line source (a line of small speakers) and produces wide dispersion in the vertical plane. This is the reverse of what one would expect intuitively. This type of horn is called a *diffraction horn.* For good horizontal dispersion it must be mounted with its major axis vertical. Diffraction horns have been built with no vertical expansion, all the expansion being in the horizontal plane.

Rectangular horns are sometimes equipped with flat vertical radial vanes, making them resemble multicellular horns, of which more later. The vanes are mainly useful in stiffening the horn structure. If the vanes are tapered so as to provide in effect several adjacent horizontally adjacent exponential horns, they do affect the polar pattern. In one design, this type of vane is placed in the section of the horn near the throat and does not extend near the horn mouth. In effect there is a small cluster of horns within the main horn, acting to shape the wave front for the higher frequencies.

A cluster of horns with small mouths, designed to have a combined mouth that is essentially part of the surface of a sphere is called a multicellular horn. Ideally, such a horn produces identical sound pressure and phase in the spherical surface formed by the mouths, acting like a section of a uniformly radiating sphere. The distribution in the horizontal and vertical planes is controlled by the number of cells in each direction.

Multicellular horns are capable of producing extremely uniform directional patterns over a wide frequency range. Just below the frequency range in which the mouth dimension is between one and two wavelengths, directionality increases. Consequently, multicellular horns cannot be used for frequencies as low as can simple horns when mouth size is a determining factor, if uniform directional patterns are required. This means that, for a given low-frequency limit, this type of horn is larger than other types.

Simple horns can be given good polar characteristics by placing acoustic lenses in their mouths. One type of acoustic lens consists of a series of closely-spaced perforated screens so arranged that the outer parts of the wave from the horn are forced to travel a longer path than those closer to the center of the lens. The progressive delay in a directional outward from the horn axis bends the outer sections of the wavefront back, producing divergence of the wave. A series of plane or curved baffles can also be used to produce path-length differences. Diffraction around obstacles is another means of altering the shape of the wavefront. Æ

We proudly present the

GARRARD ZERO 100

Two-Speed (33⅓ and 45 rpm) Automatic Turntable

$189.50

less base and cartridge

This is the brilliant new star among automatic turntables, featuring zero degree tracking error and 12 other major advances.

Again, the innovator!

The components that comprise high fidelity systems have become increasingly sophisticated. In turn, the demands placed on the automatic turntable for higher performance standards have also increased. These stringent requirements have led to higher price categories for automatic turntables than ever before.

Nevertheless, the Garrard Laboratories resisted the temptation to build a so-called "super changer", until they were satisfied that sufficiently meaningful improvements were feasible, to justify the establishment of such a new product category.

Over the years, Garrard has invented, pioneered and introduced virtually every significant new feature in automatic record playing units. Many of these have been revolutionary, and together they have upgraded the entire character of the automatic turntable.

But change, merely for the sake of change, has been sternly resisted. Therefore, such notable innovations as anti-skating controls, built-in stylus pressure gauges, cueing and pause controls, dynamically balanced low mass tone arms and combination synchronous-induction motors (to name a few) were first introduced on Garrard automatic turntables . . . but only after the need was established and they were thoroughly researched, tested and perfected. Today, they are standard on most of the higher-priced automatic turntables of all manufacturers.

The Zero 100 is a dramatic new concept, with styling as advanced as its features. It is a new classic, which others will emulate for years to come.

While the appearance of a product does not improve performance, it does connote craftsmanship and quality — and reflects the aesthetics most people appreciate in products which are precision-engineered. In the Zero 100, new materials have been used — such as plexiglas, brass, machined parts, satin finish aluminum — all set off on a sparkling white unit plate. Garrard has made the Zero 100 the very personification of quality. ☐

Heart of the **ZERO 100** is a revolutionary new tone arm

"ZERO" stands for Zero Tracking Error

The maintenance of zero degree tracking error over the full surface of the record has long been an experts' dream. From an engineering standpoint, the value of the principle is well-recognized, not only for obtaining the finest sound reproduction and eliminating distortion, but for preserving the record grooves. The problem has been to obtain these results with minimal friction and realistic cost. Since the feature is so desirable, there have been some separate tone arms and manual combinations attempting to play records back with zero degree tracking error, but these have had unacceptable friction levels, or were unduly expensive. Certainly, they could not be used on automatic players.

Garrard has spent many years on this development, discarding hundreds of ideas which did not meet its criteria. Now, at last, this advancement of the first magnitude is presented for home use on the Zero 100 automatic turntable.

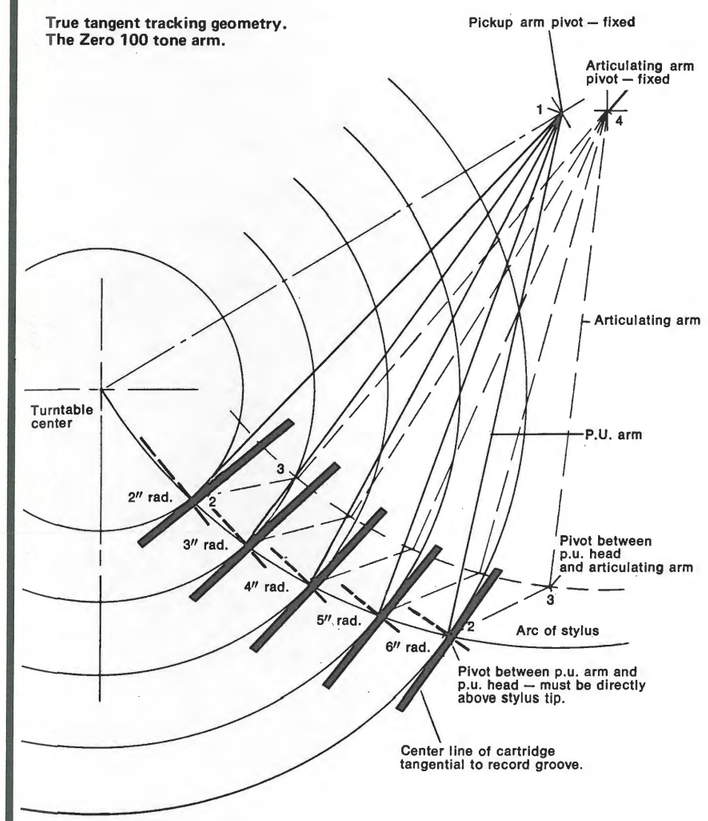
How the arm is built

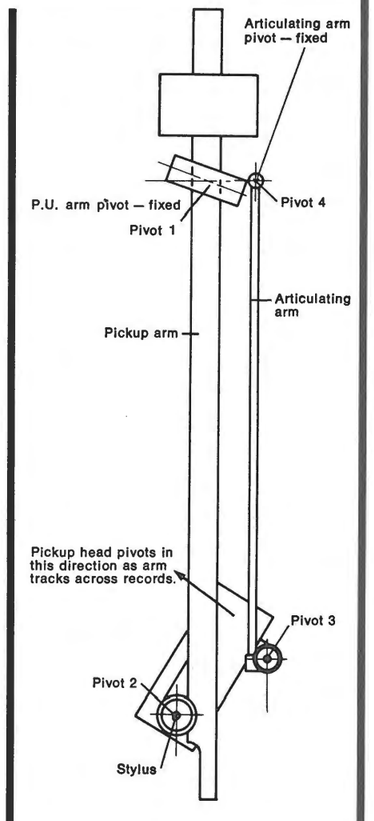
In common with many examples of engineering ingenuity, the solution to the problem of tracking error looks deceptively simple on the surface.

The new arm is designed so that the cartridge housing is pivoted directly above the stylus tip. The degree of pivot is controlled by an auxiliary articulating arm. The amount of cartridge head pivoting, the length and position of the articulating arm . . . indeed, all the complex geometrical problems involved . . . were solved and optimized by computer. Without this procedure, the successful design and execution of this tone arm would have been impossible.

The combination of computerized design and arm articulation through advanced pivotry, results in the tracking geometry shown in the diagram. Note that the stylus is perpendicularly tangent to the groove throughout the record — a dramatic achievement of primary importance in the search for perfect reproduction.

True tangent tracking geometry. The Zero 100 tone arm.

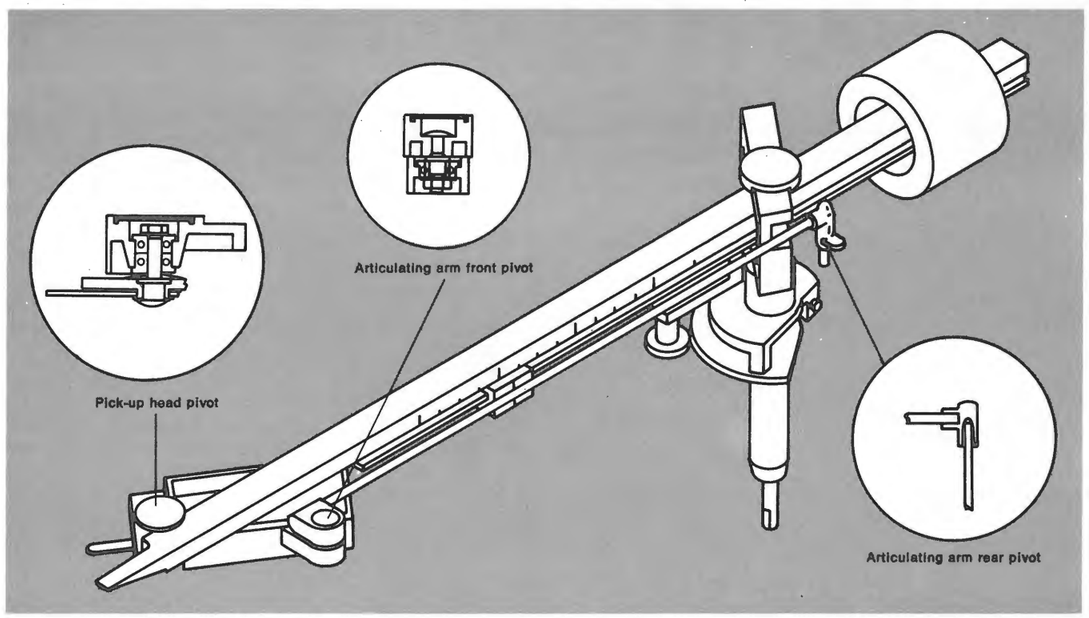




Advanced pivotry for minimal friction

The extremely low — in fact, negligible friction — which is essential to this concept, has been achieved with costly, precision-loaded ball bearings, and a free-floating universal pivot. These are among the very few parts of the Zero 100 which Garrard does not build. Instead, they are purchased from an outstanding manufacturer specializing entirely in the design and construction of pivots for gyroscopes and other sophisticated space-age equipment. The articulating arm, which depends upon this advanced pivotry, is fashioned of stainless steel tube by Garrard.

Records are made with the cutter perpendicular (tangent at right angle) to each groove. When a conventional tone arm plays this back, the arm describes an arc from its pivot. Because of the fixed head, it produces a varying amount of tracking error, which can only measure zero at the two points where the cartridge is truly perpendicular to the groove. Tracking error, therefore, is inherent in the performance of all conventional tone arms. It is measured and expressed in degrees per inch. It produces distortion in the second harmonic, and, until now, could not be successfully eliminated by any tone arm on automatic playback units.



Tracking error up to 160 times as low per inch as standard tone arm!

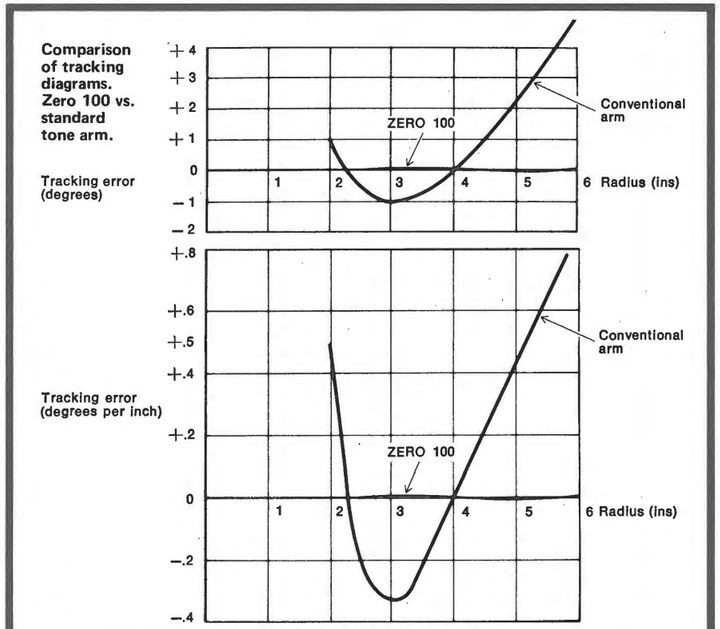
A comparison of the tracking error measurements of any conventionally pivoted tone arm with those of the Zero 100, indicates the magnitude of the breakthrough which Garrard has achieved.

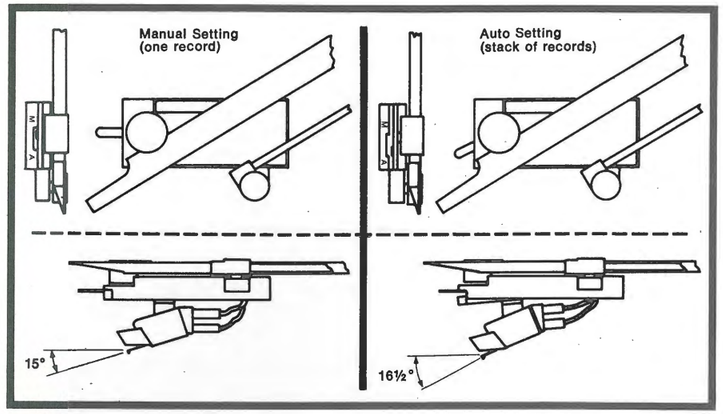
Consider that there are 3,600 seconds of arc in a degree . . . and that a conventional tone arm may produce tracking error as high as 4 degrees, or 14,400 seconds at its full playing radius. The tracking error of the Zero 100 tone arm is calculated to measure a remarkable 90 seconds, placing it in the area of 160 times as small per inch as the error of conventional tone arms.

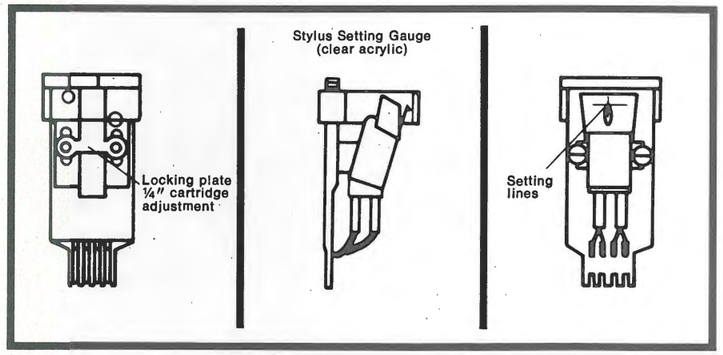
The true tangent tone arm clearly establishes the Zero 100 as a revolutionary development of the first order.

Conversely, above and beyond the tone arm, the features described on the following pages place the Zero 100 in a class by itself, at the very forefront of all automatic turntables available today.

Comparison of tracking diagrams. Zero 100 vs. standard tone arm.







15° Vertical tracking adjustment

Discs are recorded with the cutter set at 15°. Therefore, for the finest reproduction, the stylus should approach this angle as closely as possible. The Zero 100 tone arm shell provides an adjustment lever for this purpose. When single records are played, a flick of the lever to "Manual" sets the cartridge and stylus angle at precisely 15°. When a stack of records is played, the lever is moved to "Automatic," and the angle of the stylus will be precisely 15° at the third record. □

Cartridge overhang adjustment

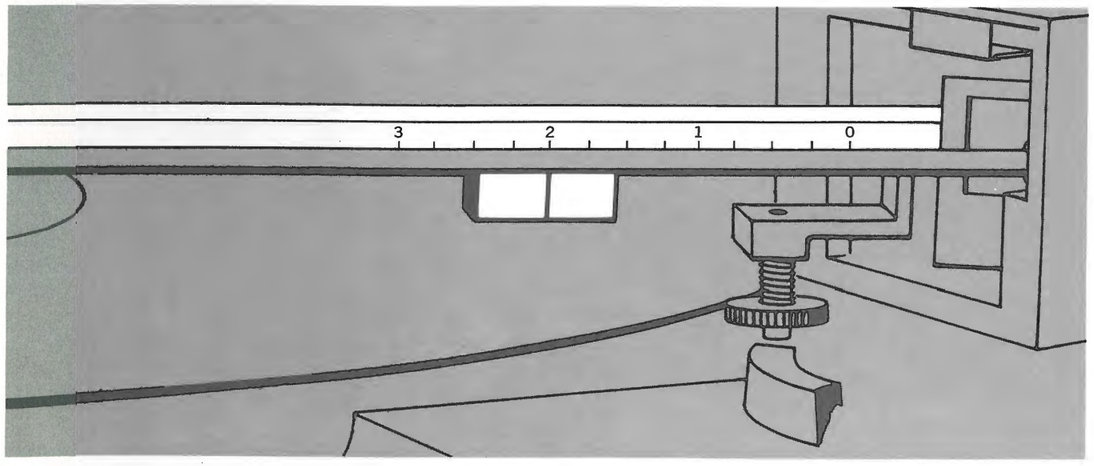
In order to assure the full benefits of zero degrees tracking error, and the 15° adjustment, the stylus tip must be positioned with absolute accuracy. The slotted cartridge carrier of the Zero 100 is provided with a lucite gauge, used when the cartridge is mounted. The cartridge carrier is inserted into the gauge, and the cartridge is accurately positioned for mounting by simply moving it to the point where the stylus tip lines up with the two cross hairs on the gauge. □

Sliding weight for setting stylus force along an extended scale

In order to impart stability and precision to the increasingly important stylus force setting, the Zero 100 tone arm utilizes a brass weight which slides under the arm.

With the weight set at "Zero", the arm is balanced to a neutral "see-saw" position. The weight is then moved forward under the arm to set in the correct stylus force. It is frictionally engaged to the tone arm, to retain its exact position; yet it can be easily moved when desired.

Since it requires a movement of 1⅛" to change the stylus force by one gram, a fraction of a gram can be set with extreme accuracy. This carries through the concept of the Zero 100 tone arm, which is designed to track the most sensitive cartridges at the precise fractional forces required for their optimum performance. □



Magnetic anti-skating control

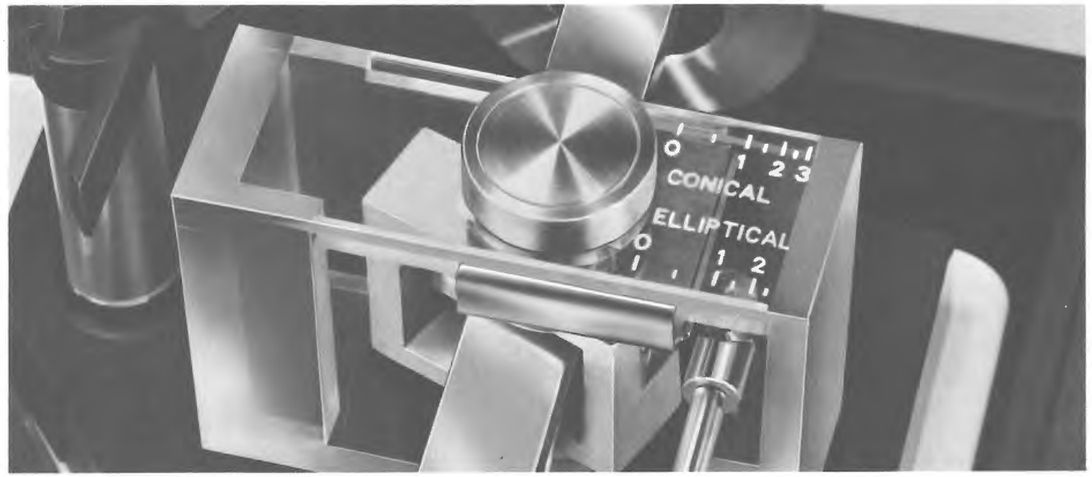
Garrard introduced the first anti-skating device in an automatic turntable with its patented sliding weight design, which is still used in the (up-to-now) 3 top Garrard models.

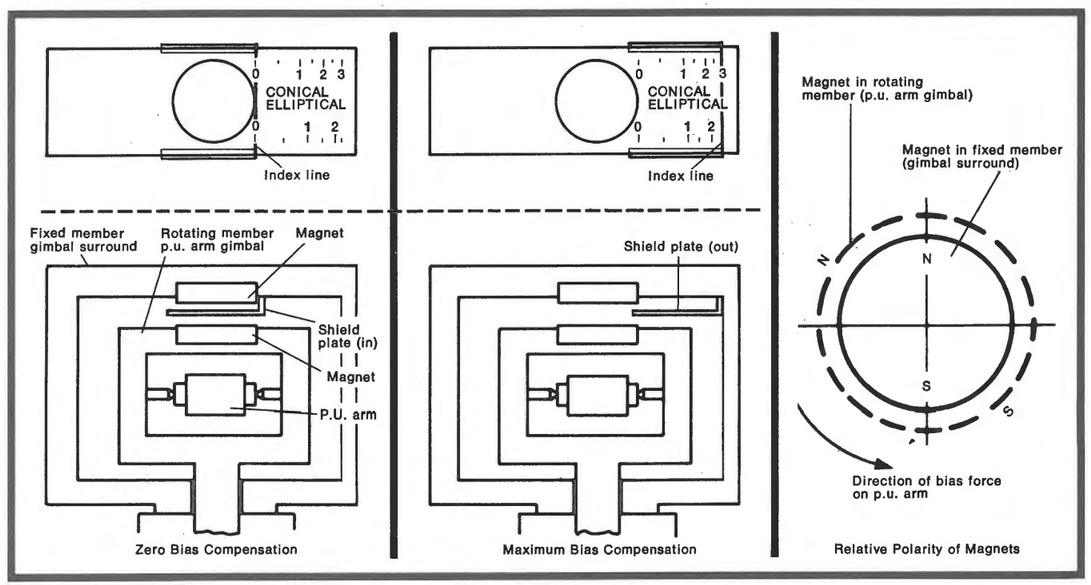
An anti-skating control is necessary to offset the normal tendency of the tone arm to move (skate) across the record toward the center. As the disc revolves, with the arm tracking, an inward skating force is created which must be counteracted and neutralized by an equal force in the opposite direction. This prevents wear on the inner side of the groove, premature damage to the record, and distortion.

Now, a unique and exceptionally precise anti-skating control has been designed for the Zero 100 and built into the tone arm assembly. A precision sliding scale, calibrated in fractions of a gram and reading conveniently from the top, shows the exact amount of anti-skating force being applied. The scale has two settings: one for elliptical; the other for conical stylii.

The simple but ingenious Zero 100 anti-skating control utilizes the well-known magnetic principle that like poles repel each other. Built differently than any previous device of its kind, it is frictionless; not mechanically connected to the tone arm; and requires neither springs nor weights.

A ceramic disc magnet is mounted on the pivoting tone arm gimbal; and another affixed above it on the rigid plexiglas tone arm housing. A ferrous metal shield, with the precision reading scale mounted on it, slides between the two magnets, to set the anti-skating force desired. When the shield is between the total areas of the magnets, they have no effect on each other, since the shield blocks the magnetic flux. However, as the shield is moved outward, it exposes the magnetic field, creating an infinitely variable amount of magnetic repulsion. This, in turn, exerts a controllable and measurable twisting force on the tone arm, as the two magnetic poles push apart, establishing the correct starting amount of anti-skating force desired, as indicated on the reading scale; and varying to the correct force required at every distance from the center of the record as the stylus moves inward along the radius. □

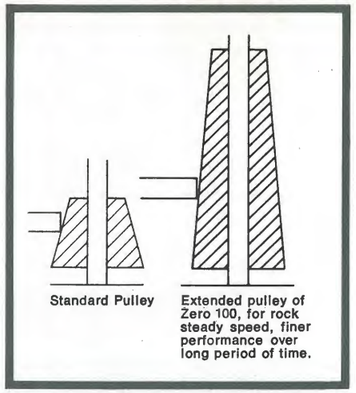




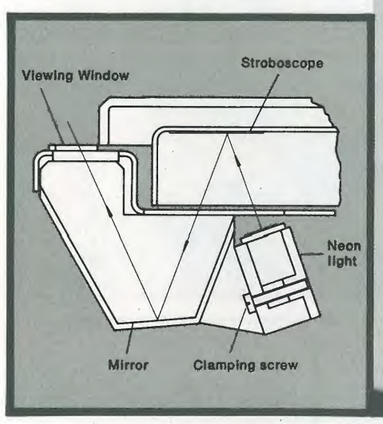
Variable speed control
(±3½% @ 33⅓ ±2½% @ 45 rpm)
Variable speed is actually non-essential for the usual listening purposes when the record playing unit is equipped with a synchronous motor, since the motor insures accurate, stable speed. However, it is a welcome convenience for critical listeners with perfect pitch who prefer to play recordings at the exact speed they select; for others who simply enjoy records best at speeds they determine themselves; and for musicians who wish to "tune" the record player in order to accompany a musical instrument.

Variable speed units are not new. For satisfactory performance, the inherent requirements are to have a completely stable motor, and a minimal taper on the pulley which controls the speed variation, so that it does not introduce wow or flutter. Now, with Garrard's proven synchronous motor, and with the development of a long, very slightly tapered pulley, the speed control in the Zero 100 has achieved the necessary degree of perfection.

Speed variation in the Zero 100 is approximately ±3%. This creates an adjustment in pitch equivalent to one semi-tone. □

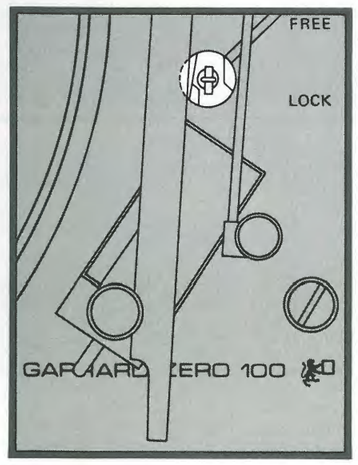


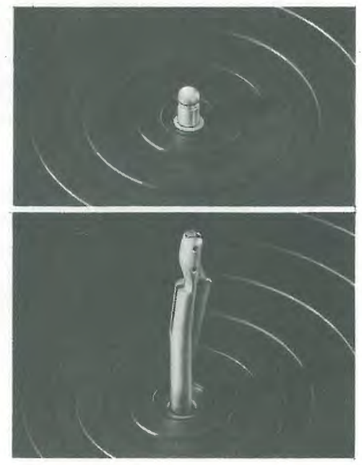
Illuminated stroboscope
(Essential with variable speed.)
The speed of the turntable is easily and accurately adjusted by moving a ring around the control knob which sets speed and record size. It can be monitored continuously through the stroboscope window, by watching the highly visible, illuminated line. □



Tone arm safety restrictor
No effort has been spared by the Garrard Laboratories to insure enjoyment by the owner. One example is the tone arm safety restrictor built into the Zero 100 tone arm to prevent it from being set down on the unit plate outside the edge of the record. A positive stop prevents accidental damage to the stylus. □

Interchangeable spindles
There are two instantly removable spindles. The short one, for single play, rotates in the same manner as spindles on manual turntables. The long spindle accommodates a stack of six records for automatic play at 33⅓ rpm. An optional automatic spindle is available for wide hole, 45 rpm records. □

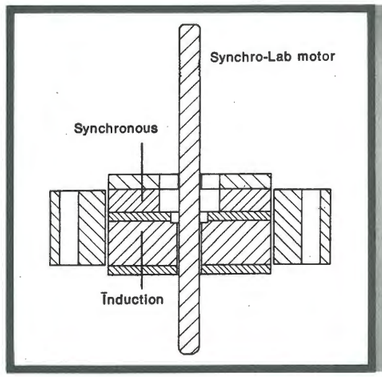


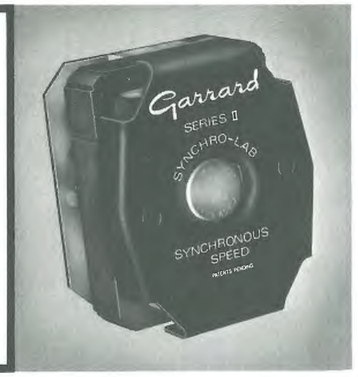


Proven features retained
The innovations described on the previous pages are all introduced for the first time on the Zero 100. In addition, it retains the fully-tested major features of the advanced series of Garrard automatic turntables, which it now heads.

GARRARD ZERO 100

SPECIFICATIONS: 2 speed, 33⅓ and 45 rpm. 100-130 volts, 60 cycles AC (50 cycle kit available).
MINIMUM CABINET DIMENSIONS: Left to right, 15⅝". Front to rear, 14⅛". Above motor board, 4¾". Below motor board, 2⅛".
MINIMUM CABINET DIMENSIONS (Turntable on Base with Dust Cover): Left to right, 16¾". Front to rear, 15¾". Top to bottom, 8¼".

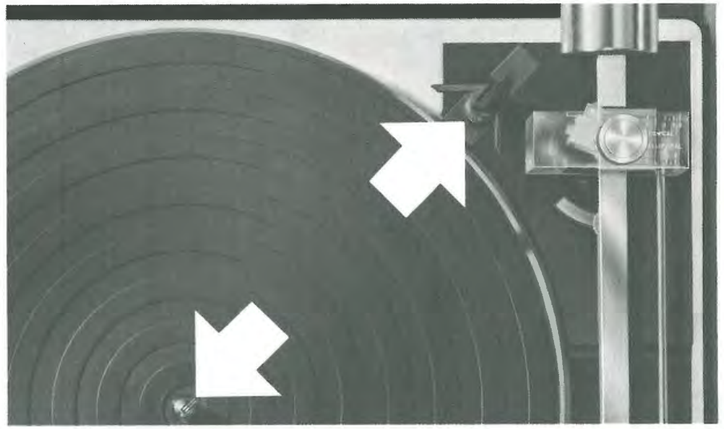




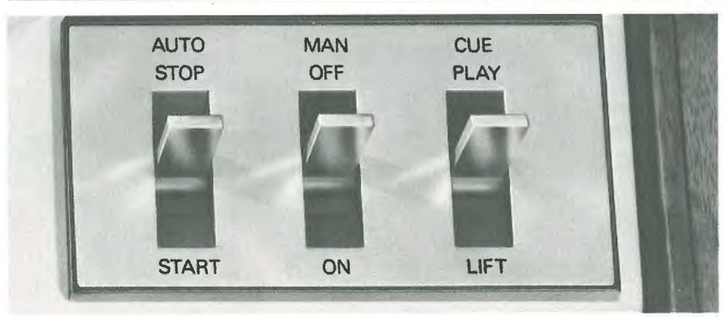
Retained— The Garrard Synchro-Lab Motor, an ingenious concept based upon split-rotor design. It combines the powerful torque and instant acceleration of the traditional induction motor; with the unwavering, perfect speed of a synchronous motor, locked into the accurately controlled 60-cycle frequency of the electric current. With the Synchro-Lab Motor, there are no changes in musical pitch caused by drops in voltage due to appliances or other heavy loads on the line at the same time. □

Retained—The Garrard full-diameter turntable. One of the advantages of the synchronously driven Zero 100 is that it does not require a heavy turntable to act as a flywheel, as would an induction motor. Instead, there's a full-sized aluminum turntable, carefully balanced and matched to the kinetic energy of the Synchro-Lab Motor. The turntable mat is heavily ribbed for easy cleaning and safe support of the record through its full diameter. □

Retained—Two point record support. Garrard's exclusive record support system guarantees utmost safety and reliability. Records on the Zero 100 are handled automatically with the care and delicacy they require for long life and fine performance. The record stack is supported at the outer edge by a sturdy platform. The oversized clip at the top of the platform is easily grasped, quickly raised over the stack, where it acts as an effective stabilizer. Records are supported positively, and drop into place on a micro-cushion of air. □



Retained — Unitized escutcheon with finger-tab, cue/pause control. Putting the right controls, in the right form, in the right place (a concept known as "human engineering") is an important Garrard feature. The Zero 100 incorporates a handsome control panel with three customized finger-tab controls: one to run the machine on automatic; one for manual operation; and the third for viscous damped cue and pause control. □



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corders is insufficient for much
today. If a piano played fortis-
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in each band and thereby over-
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notes because lower level signals
simplified high band version of
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and expansion after recording.
System reduces noise from 10 to
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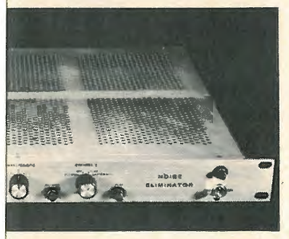

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Reduction

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ard

110dB Dynamic Range For Tape

Richard S. Burwen*

All of this is predicated upon an input signal coming from noiseless studio equipment. In practice, of course, the extremely wide dynamic range of the tape recording system will simply uncover the noise in the studio console that was previously negligible. One possible solution when making multi-track recordings is to record directly from a high quality capacitor microphone preamplifier which can have a dynamic range in excess of 110 dB.

Compatibility

One facet of the Noise Eliminator system being investigated at the present time is the possibility of compressing the signal prior to broadcasting FM or AM or making reel to reel tapes, cassettes, and phonograph records. For highest quality reproduction of a compressed signal the audio hobbyist would have to own at least a simplified version of the playback expander. For those who do not own an expander listening to the compressed signal can still be quite pleasant.

Unlike the Dolby System which changes the frequency response of the compressed signal in accordance with its level, the frequency response of the Burwen Laboratories system is constant. Although the signal is greatly compressed and the VU meter hovers around zero, the psychological dynamic effect of the music is to a considerable extent restored by a moderate amount of low frequency and high frequency pre-emphasis included in the record signal processing. As background music the compressed signal sounds quite pleasant because even very low level passages can be heard.

The principal disadvantage in listening to the compressed signal is the substantial increase in the studio console amplifier noise that can be heard, particularly if the music stops altogether. This problem can be alleviated by occasionally turning down the gain on the compressed signal. Alternatively the maximum gain of the compressor can be limited so that the background noise in the absence of music will not be so high.

Provided the compressors in a stereo system are ganged to avoid changing the directional effect, compressed music, starting with a moderate dynamic range, can be described as fairly compatible. Further development work is under way with the aim of making wide dynamic range compressed music more compatible using automatic signal processing.

Basic System

As mentioned earlier the Burwen Laboratories system is based on a combination of pre-emphasis and compression in the record electronics and expansion and de-emphasis in the playback electronics. It takes advantage of advances in record-

110 dB Dynamic Range For Tape

Richard S. Burwen*

It is now widely recognized that the signal-to-noise ratio of even the best studio tape recorders is insufficient for much of the recording performed today. If a piano played fortissimo is recorded on four-track ½" tape with peaks reaching the 2% distortion level and then played back at the original acoustic level, the hiss is not only audible but objectionable. With other types of program material noise becomes objectionable after the several rerecordings common to the preparation of a prerecorded tape.

For this reason studios are turning to electronic methods for further processing the signal to reduce the noise. One system available is the Dynamic Noise Filter [1] manufactured by Burwen Laboratories. This system reduces noise by attenuating the high and low frequencies in a band-pass filter whose bandwidth is extended with each musical note and contracted between the notes. Due to the characteristics of the ear the noise that is present during each note is masked by the music.

Another signal processor available is the Dolby Laboratories Noise Reduction System [2] which is used in making new tape recordings but is not designed to improve existing noisy program material. The Dolby System compresses the signal in four separate frequency bands before recording in order to maintain a higher signal level on the tape in each band and thereby overcome the noise. A complementary four band expander used for playback restores the signal to its original level and flat response and reduces the noise between notes because lower level signals are played at reduced gain. A simplified high band version of the Dolby System is now coming into use in consumer equipment and prerecorded cassettes.

A new system to be described, the Burwen Laboratories Noise Eliminator, Fig. 1, is also based on the principle of signal compression before recording and expansion after recording. Whereas the Dolby Type "A" System reduces noise from 10 to 15 dB, the Burwen Laboratories Noise Eliminator reduces noise as much as 50 to 60 dB.

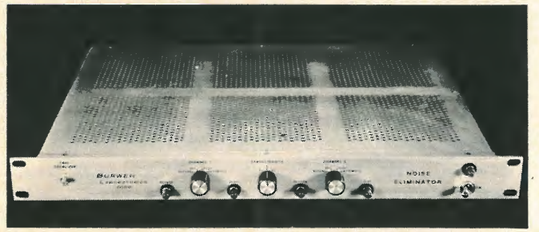

Fig. 1—Two-channel Noise Eliminator.

Effect of 50-60 dB Noise Reduction

With such a tremendous increase in the dynamic range the recording engineer gains a new freedom. No longer does the signal level have to be set so the VU meter reaches precisely into the red region and not beyond. An A-B comparison of the source and playback signals in headphones when recording a piano shows no audible difference. In fact the input level can be reduced 30 dB while the output is magnified 30 dB and the audible noise is less than that in a normal recording. When dubbing from a conventional tape a reduction in input level as much as 40 dB still produces a good dub. The greatest benefit, of course, is in making recordings at proper input levels in which case tape noise is audibly eliminated. Swishing noises are not apparent in spite of using a single wideband compressor because the instantaneous signal-to-noise ratio is very high for a wide range of input levels.

***Burwen Laboratories,**
12 Holmes Road,
Lexington, Mass. 02173

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Basic System

As mentioned earlier the Burwen Laboratories system is based on a combination of pre-emphasis and compression in the record electronics and expansion and de-emphasis in the playback electronics. It takes advantage of advances in record-

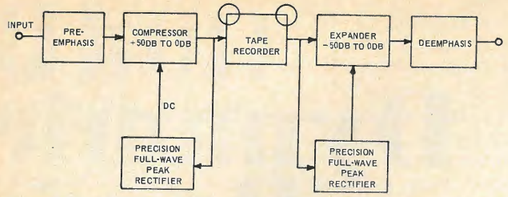

Fig. 2—Simplified system diagram.

ing tape technology made in recent years which result in increased flux density on the tape at high frequencies for a given record head current. Present day recorders having NAB playback response cannot properly take advantage of modern low noise tapes because of the standardized playback response curve.

When a high resolution, low noise tape is used the high frequency pre-emphasis in the record amplifier is reduced so that the flux recorded on the tape relative to middle frequencies is no greater than with ordinary tape. The net result is a very slight improvement due to the lower particle noise of the tape and possibly a 1 or 2 dB increase in overall output. At speeds of 7½ and 15 ips it is possible to improve the signal-to-noise ratio by from 6 to 12 dB simply by pre-emphasizing and de-emphasizing the high frequencies more than in a standard tape recorder.

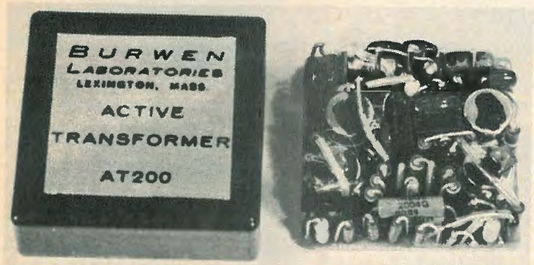

Fig. 3—The active transformer module.

In the basic system diagram, Fig. 2, the record compression system is shown on the left of the tape recorder and the playback expansion system on the right. The record signal first passes through a pre-emphasis network which increases the high and low frequency gain and then into a variable gain amplifier used to compress the signal by as much as 50 dB. The gain of the compressor is determined by its output signal which is fed to the record input of the tape recorder and simultaneously to a precision full wave peak rectifier.

The peak rectifier converts this signal to a d.c. gain control voltage which is smoothed by a multistage nonlinear filter. This circuit is designed for rapid compression when the input signal suddenly increases in amplitude but has a slow enough decay to prevent modulation of the signal at audio frequencies.

After the signal is recorded on the tape and played back at unity gain it is expanded in a complementary manner using a variable gain amplifier having a gain from -50 to 0 dB. The control voltage for this expander is derived from a precision full wave peak rectifier exactly the same as on the record side and which receives an input signal, the tape playback, similar to the record signal. Following the expander the high frequencies and low frequencies are de-emphasized to produce flat response for the entire system.

The combination of pre-emphasis and compressor gain of 50 dB or more increases the high frequency signal content on the tape by over 60 dB for low level signals. On the playback side the gain is reduced by the same amount and accordingly the unweighted noise level is reduced between 50 and 60 dB.

Because the compressor follows the pre-emphasis network its own noise is less significant and the tendency of the pre-emphasis network to overload the tape on high frequency input signals is greatly reduced because the compressor tends to hold the signal more nearly constant. Unlike the signal emerging from a conventional volume limiter the signal on the tape must have variations in peak amplitude. Otherwise the playback expansion side of the system could not determine how much to expand the signal. The action of the compressor and expander is smooth and precise and the dynamic error at any frequency and level is typically under 1 dB.

Of particular importance in this system is the fact that there is no alteration of the frequency response even if the gain of the tape recorder is not exactly 0 dB. The only effect is a change in output level and there is not even any appreciable expansion or compression of the signal. While it is necessary to maintain a reasonable signal level at the input of the expander if the system were used for FM reception for example, the signal level could easily be set by ear with sufficient accuracy without transmitting a calibration tone.

In the Noise Eliminator system, Fig. 1, two channels are contained on a single 19" x 1¾" rack panel. The system is built using encapsulated epoxy modules such as that in Fig. 3 which are also available for building into studio tape recorders. This is an automatically switched system in which the same components used for compression in the record electronics are used for expansion in the playback electronics. When the equipment is used for two-channel recording the compressed playback signal passes directly through the instrument so it can be used for monitoring from tape. Monitoring the compressed signal is quite useful in that it readily shows up defects in the program material. Switching from record to playback can be either via front panel switches or remotely from the tape recorder.

The input and output levels are +4 dBm at 0 VU but can be adjusted internally for other levels. A d.c. coupled differential input amplifier called the "Active Transformer" is used in place of the usual input transformer and the d.c. coupled system output will feed any load from 150 ohms to an open circuit with negligible change in frequency response.

Future Uses

The general usefulness of the Burwen Laboratories Noise Eliminator system has only begun to be explored. Besides reducing noise in studio masters and consumer recordings, processing the compressed signal through the studio console can produce some interesting effects. For example, boosting the bass and treble a few dB will result in expansion upon playback during orchestral crescendos which increase the dynamic effect of the music without causing the usual boominess due to excessive bass. Mixing compressed signals together can produce an effect whereby a predominant instrument can cause an increase in the level of all the others after playback expansion. Reverberation in a compressed signal sounds as though it has been increased because the number of dB the music level can decay in a given time has been reduced.

It is anticipated the availability of wide dynamic range recording will have a substantial impact upon the recording industry and it may even spark a new generation of low noise equipment. Æ

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1. **Burwen, R.S.**, "A Dynamic Noise Filter," Journal of the Audio Engineering Society, Volume 19, No. 1, February 1971.
2. **Dolby, R.M.**, "An Audio Noise Reduction System," Journal of the Audio Engineering Society, Volume 15, No. 4, Page 383, October 1967.

Mathematics 4 Beginners

Part one of a new series by Norman H. Crowhurst

SIMPLE RESISTANCE calculations, such as "given voltage and current, find resistance," or "given voltage and resistance, find current," usually offer little trouble if we remember Ohm's law—E=IR, where I (current in amperes) equals E (electromotive force in volts) times R (resistance in ohms). And calculating parallel resistance combinations is not too difficult (we'll run through some practice examples later). But calculating voltages in an unbalanced bridge is not so easy. (If you think such calculations are easy, then this article isn't for you.)

Take the bridge George brought Henry the other day. (See Fig. 1.) George had somehow put together a bridge consisting of 15K, 10K, 12K, 18K and 6.8K, in the configuration he had sketched, which he showed to Henry, along with his calculations thus far. He had figured that the current through the 15K and the 10K, which add up to 25K, would be 0.8 mA, and that the current through the 12K and the 18K, which add up to 30K, would be two-thirds of a milliamp, or 0.667 mA. (See **Calculations** at the end of this article.)

From this he had calculated that the junction of the 15K and 10K would produce 8 volts, which checked out with 12 volts across the 15K, and that the junction of the 12K and 18K would produce 12 volts, which checked out with 8 volts across the 12K.

Finally, using the 4 volts difference between these points, he calculated that 4 volts across the 6.8K would produce 0.588 mA. But when he put it together, he did not get these results, which was why he brought the problem to Henry.

"Your calculations were all right, as far as the 8 volts and 12 volts," Henry told him, "only if you had not added the 6.8K resistor between those points. But as soon as you connect the 6.8K, that 4 volts gets loaded down."

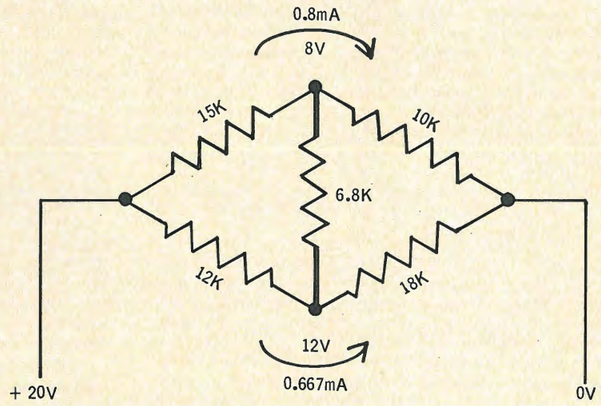

Fig. 1—George's original bridge.

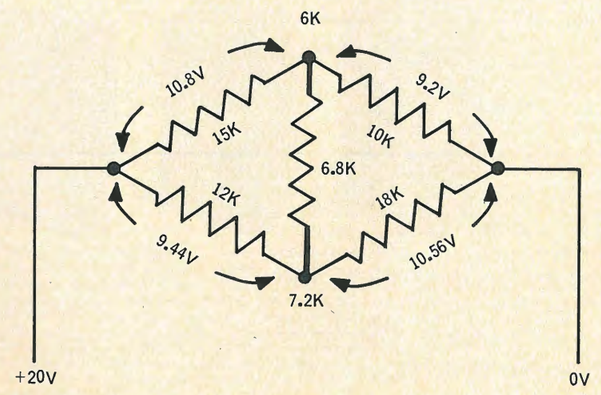

Fig. 2—The bridge with corrected figures.

"You're telling me," George responded. "That's what I found out the hard way. But how can you calculate the loading down effect?"

"Well," Henry replied, "the classic way is to write a series of equations for voltages and currents in all the components, based on Kirchoff's first and second laws, and then solve for all those variables."

"Kirchoff's law?" George interrupted, and then remembered out loud, "Oh, that's the one that says all the currents meeting at a point add up to zero, algebraically."

"And the other one says that the voltages round the loop also add up to zero," Henry filled in. "That means that the current taken by the 6.8K from the junction of the 15K and the 10K must subtract something from the current in the 15K and add something to the current in the 10K, or vice versa. And that the voltage across the 15K plus that across the 6.8K must equal that across the 12K, and so on with the rest of the circuit."

"That sounds like a lot of calculating, or juggling with equations," George commented.

"It is," Henry replied, "which is why I prefer to use a short-cut, based on Thevenin's theorem."

"What's that?" George wanted to know.

"Well, I can more easily show you how to use it, than I can put the theorem in its proper words," Henry responded. "In essence, it says that, as well as the 15K and 10K producing that 8 volts you calculated, this voltage has an internal resistance, as does the 12 volts with the 12K and 18K. As I said, your calculations were OK until you added the 6.8K resistor to the circuit."

"So how do I calculate this 'internal resistance'?" George wanted to know.

"It's simple. The two resistors that form the voltage divider, the 15K and the 10K, or the 12K and the 18K, as the case may be, are considered as being in parallel," Henry told him. He calculated that 10K and 15K in parallel made 6K, and that 12K and 18K in parallel made 7.2K, and wrote those values on the schematic, along with the voltages.

"Now, to calculate the current in the 6.8K resistor," Henry went on, "you find the total resistance that the 4 volts has to drive current through, which is 6K plus 6.8K plus 7.2K, working from top to bottom."

George added that up and it came to 20K.

"Now," Henry went on, "4 volts across 20K yields 0.2 milliamps, not the 0.588 milliamps you calculated, based on the 6.8K alone."

calculations

20V/25K = 0.8mA
0.8mA x 10K = 8V
0.8mA x 15K = 12V

20V/30K = 0.667mA
0.667mA x 18K = 12V
0.667mA x 12K = 8V

4V/6.8K = 0.588mA

(15 x 10)/25 = 6K (12 x 18)/30 = 7.2K
6K + 6.8K + 7.2K = 20K
4V/20K = 0.2mA
0.2mA x 6K = 1.2V
8V + 1.2V = 9.2V
0.2mA x 7.2K = 1.44V
12V - 1.44V = 10.56V

10.56V/18K = 0.5867mA
9.44V/12K = 0.7867mA
10.56V - 9.2V = 1.36V
9.2V/10K = 0.92mA
10.8V/15K = 0.72mA
10.56V/18K = 0.5867mA
9.44V/12K = 0.7867mA
1.36V/6.8K = 0.2mA
0.92mA - 0.72mA = 0.2mA
0.7867mA - 0.5867mA = 0.2mA

"That begins to look more like it," George said, "but how do you calculate the new voltages caused by adding this 6.8K resistor to the circuit?"

"Well," Henry replied, "we can use those internal resistance values again. The voltage always moves toward the other one, so the voltage across the connection—the 6.8K—drops, due to the internal resistance. So the 8 volts at the junction of the 15K and 10K will rise, while the 12 volts at the junction of the 12K and 18K will drop."

"I see," George commented.

"Now, the internal resistance at the junction of the 15K and 10K is 6K, and 0.2 milliamps through 6K produces 1.2 volts. So the 8 volts rises to 8 + 1.2 = 9.2 volts."

"And the internal resistance at the junction of the 12K and 18K is 7.2K," George went on, catching the idea, "so 0.2 milliamps produces a change of 0.2 times 7.2," and he multiplied it out, "or 1.44 volts. Let's see, that subtracts from 12 volts," Henry nodded as George looked at him for confirmation, "leaving 10.56 volts."

They both looked at that for a moment, but Henry sensed that George was still a little unsure, although it looked right.

"Now you have all the voltages," Henry suggested, "you can check your calculations by figuring all the currents. The 10K has 9.2 volts across it, so it passes 0.92 milliamps. The 15K has 10.8 volts across it, so it passes 10.8 divided by 15K or 0.72 milliamps. The difference is 0.92 - 0.72 or 0.2 milliamps, which agrees with our earlier calculation. You can do the same thing with the 12K and 18K."

George took this up, and calculated the currents by long division, to be 0.5867 and 0.7867, which again differed by precisely 0.2 milliamps.

"And finally," Henry added, "you can take the difference between 10.56 volts and 9.2 volts, which is 1.36 volts, and verify that this results from 0.2 milliamps flowing in 6.8K."

George just verified this for himself and then smiled. "That is a lot easier than I thought it would be. But then things usually are, when you know how. What I would really like to know is how one can figure out a circuit like this to allow a certain voltage and current set, and then when you remove the middle resistor, the voltages go to some other set of figures you have predetermined."

Just then the whistle down the street proclaimed it was going home time, so Henry promised to show George this some other time. Æ

Equipment Profiles

Fisher Model 201 Stereophonic AM-FM Receiver

MANUFACTURER'S SPECIFICATIONS
FM Tuner Section: IHF Sensitivity: 2.5 μV. **S/N Ratio:** 60 dB. **THD:** 0.5%. **Selectivity:** 36 dB. **Image Rejection:** 46 dB. **IF Rejection:** 65 dB. **Capture Ratio:** 3 dB. **Stereo FM Separation** (1 kHz): 35 dB.
AM Tuner Section: Sensitivity (loop): 270 μV/M. **Selectivity:** 44 dB. **Image Rejection:** 36 dB. **IF Rejection:** 50 dB.
Amplifier Section: Power Output: IHF Dynamic Power, 25 watts/channel; RMS Power, 20 watts/channel. **THD:** 0.8% at rated output. **IM:** 1.2% at rated output. **IHF Power Bandwidth:** 25 to 20,000 Hz. **Frequency Response:** Phono, 35 to 15,000 Hz $\pm$ 2 dB; Aux. 1, 2 and Tape Monitor, 25 to 20,000 Hz $\pm$ 2 dB. **Hum and Noise:** Phono, -60 dB; Aux. 1, 2 and Tape Monitor, -65 dB. **Input Sensitivity:** Phono, 8 mV; Aux. 1, 2 and Tape Monitor, 200 mV. **Damping Factor:** Greater than 10. **Tone Control Range** (Bass and Treble): 24 dB @ 50 Hz and 10 kHz.
General: Dimensions: 15-11/32 in. W. x 4⅜ in. H. x 14¼ in. D. **Price:** $199.95

Fisher Radio has joined a growing group of domestic high fidelity manufacturers who, in the interest of introducing lower cost equipment, have sought additional manufacturing sources abroad. Both the new Model 201 and the somewhat higher powered (and more expensive at $249.95) Model 202 Receivers recently introduced by this justly respected firm are manufactured for them in Japan. The "Fisher Touch," however, is unmistakable, and it would be our guess that design efforts, engineering and even production procedures were carefully initiated and executed by the home-based engineering and production talent. The front panel of the new Model 201 is replete with the familiar "bird-with-note-in-beak" trademark.

The light-gold and black heavy anodized front panel features an upper dial area which is "blacked out" until power is applied to the unit. Controls arranged along the lower half of the panel include a combination power/speaker selector switch (including positions for main, remote, both sets of speakers or phones-only), a bass control, treble control, balance and volume control as well as the usual source selector switch. In addition to these rotary controls, four "piano-key" buttons control loudness-contour, stereo-mono mode, tape monitor and a novel new control identified as "volume." This latter control, when depressed, simply reduces volume level by a fixed 20 dB—a useful feature to use when the phone rings and you don't want to upset your pre-set volume level for later listening. In the costlier Model 202 receiver, by the way, this control is replaced by an FM interstation muting switch—another difference between these two models.

The upper, blackout portion of the panel includes a well-calibrated (every MHz) dial scale for AM and FM tuning together with a linear logging scale, a peak-reading tuning meter (above which is printed the word "stereobeam" which becomes brightly illuminated in the presence of an incoming stereo FM signal) and a large tuning knob, coupled to a moderately effective flywheel. Stereophone jack facilities at the lower left of the panel complete the front layout.

The rear panel includes input jack pairs for Phono, Aux 1 and 2 and Tape, a pair of Recorder Out jacks, an antenna terminal strip for FM antenna connection (300 ohms), and external AM antenna. Speaker terminals for both main and remote speakers are widely spaced to prevent possible shorts. An FM attenuator switch introduces a resistive attenuator network in the antenna circuit when switched to the "local" position. A pivotable AM ferrite antenna, an a.c. convenience outlet, fuses for a.c. and speaker lines, and a grounding terminal screw complete the rear panel layout.

Modular printed circuit board construction is used throughout the Model 201, as can be seen in the internal view. Separate AM and FM front ends are utilized, the latter being fully sealed in a metal shield housing. Separate modules are used for the i.f. stages, preamplifier, control amplifier, power amplifiers driver (a pair of identical p.c. boards), multiplex FM and power supply parts for a total of nine separate modules. Power output circuitry utilizes a pair of NPN transistors in a push-pull configuration, driven by a complementary NPN-PNP pair of drivers, eliminating the need for driver or output transformers. Supply voltage is 62 volts, with center voltage factory-adjustable to exactly 31 volts for perfect symmetry of output and absence of cross-over distortion. One channel of power amplifier circuitry is shown in Fig. 3. Tone controls are of the popular Baxandall (variable crossover feedback) type. The FM i.f. section includes integrated circuits for gain and limiting, an input bi-polar NPN transistor and a conventional ratio detector.

Fig. 1—Showing the rear panel of the Fisher Model 201.

Test Measurements

While the published specifications which appear in the instruction manual for the Model 201 are not specifically listed as guaranteed minimums, our measurements would tend to confirm that this is in fact the case—either that or Fisher is being *extremely* conservative in its statement of specs. Too many of the measurements we made turned out to be much better than claimed. For example, IHF sensitivity (which Fisher claims to be a modest 2.5 microvolts) was measured at 1.9 μV—the equal of far more expensive receivers. Ultimate signal-to-noise ratio actually measured a very superior 73 dB (as against only 60 dB claimed by the manufacturers). These findings are illustrated graphically in Fig. 4. THD in mono conformed exactly to the 0.5% claimed, and full limiting was achieved at just under 2 microvolts. As for stereo FM separation, the 35 dB figure claimed was exactly met at mid-band frequencies but, perhaps more importantly, at least 30 dB of separation was maintained all the way down to 50 Hz, while high end (15 kHz) separation was never less than 25 dB, as shown in Fig. 5.

The power amplifier section did better than claimed as well. We measured 22 watts per channel rms before reaching the rated harmonic distortion of 0.8%, and that was with both channels driven. At all power levels below 18 watts per channel, THD measured less than 0.1%. As for IM distortion we did not reach the rated 1.2% stated by the manufacturer until the amplifier was producing a total of 23 watts per channel. The curves of these measurements are presented in Fig. 6 and in the case of IM, at all power levels below 12.5 watts, measured IM was less than 0.1%.

Power bandwidth, shown graphically in Fig. 7, was just a bit better at the low end than claimed and equalled the manufacturer's claims for the high end, extending from 22 to 20,000 Hz. Hum and noise on Phono exactly equalled the 65 dB claimed while in the case of high level inputs such as AUX and Tape Monitor, we measured hum and noise at 80 dB below rated output, as against the modest 65 dB claimed in the published specs.

Frequency response extended from 20 to 23,000 $\pm$ 2 dB with a fairly rapid roll-off above and below these frequency extremes. Tone control action, illustrated in Fig. 8 conformed with claims in the bass region, but was a bit less than full-range in the treble range, where maximum range measured 22 dB (+12, -10) at 10 kHz, as opposed to the 24 dB total claimed. Square wave response for a frequency of 10 kHz tended to be a bit rounded because of the rapid roll-off above 20 kHz, but there was no evidence of "ringing" or overshoot.

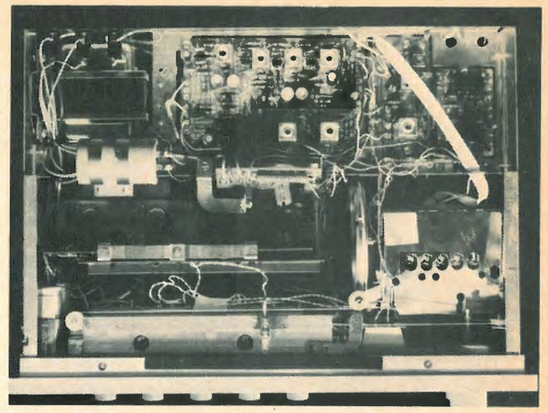

Fig. 2—Showing the Fisher Model 201 from above.

Listening Tests

We used the Model 201 receiver with medium efficiency as well as with low efficiency speaker systems. In the case of the higher efficiency systems, we were able to produce "concert hall" volume for recordings having wide dynamic range with no evidence of break-up at either frequency extreme at volume settings of about "9 o'clock." In the case of the low-efficiency systems, however, the amplifier seemed to "labor" in an attempt to give us equivalent loudness and there was evidence of low-frequency distortion, particularly when we tried to add a moderate amount of bass boost by means of the tone control. Twenty watts, however honestly produced, is just a bit on the low side for driving some makes of speakers—and it follows that an attempt to use *two* sets of low efficiency systems, operating simultaneously in different rooms, would further emphasize this limitation. Though we haven't had an opportunity to measure the Model 202 "first cousin" receiver, we suspect that its extra few watts per channel would have made the difference here. The Model 202 boasts 25 clean watts per channel rms. At lower listening levels, however, the 201's sound was extremely clean and the combined use of the loudness control at mid-volume settings, together with a moderate amount of bass boost and treble emphasis (to take care of our some-

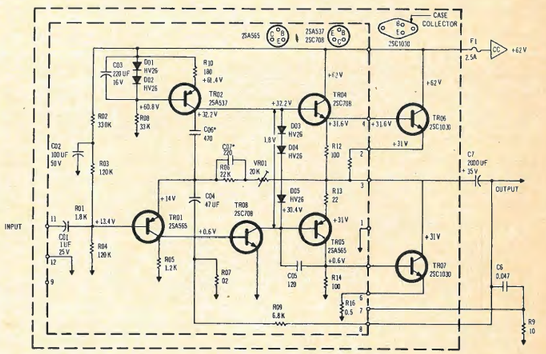

Fig. 3—Schematic diagram of one channel of the power amplifier section.

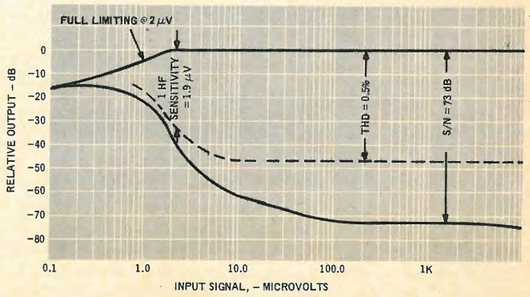

Fig. 4—FM performance characteristics.

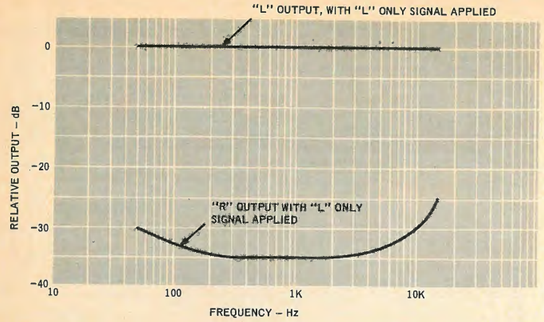

Fig. 5—FM stereo separation.

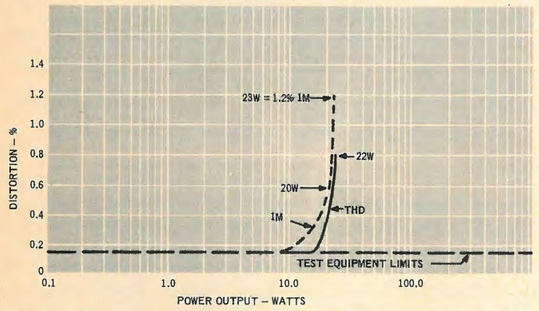

Fig. 6—IM and THD distortion levels.

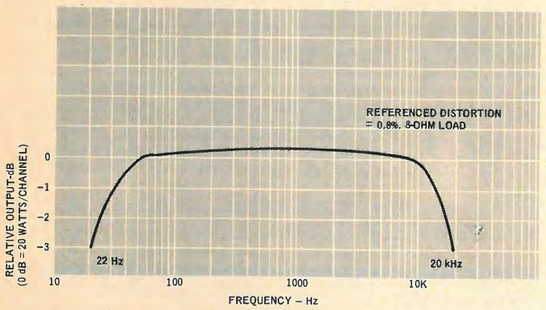

Fig. 7—Power bandwidth.

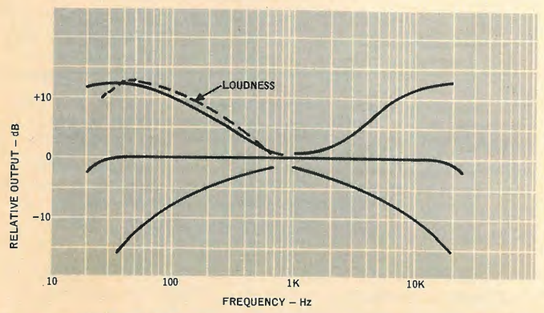

Fig. 8—Tone control, frequency response, and loudness contour characteristics.

what "soft" listening room), provided musical reproduction such as we have come to expect from more expensive units. Of course, frills such as high and low frequency filters are missing, in the interest of economy, but with good source material on hand, such devices are seldom used by most listeners anyway. Transient response was good, and hum and noise in all services was adequate. Tracking of the volume control, by the way, was excellent and we found it unnecessary to readjust the balance control even at very low background-music listening levels. Perfect balance was maintained when the "volume attenuator" described earlier was used, and it is, by the way, a worthwhile feature that might well be incorporated in other models.

In deciding whether or not to spend the extra $50.00 for the step-up Model 202, be guided primarily by the amplifier differences, since the tuner sections (aside from the muting circuit available on the higher priced model) are identical, we are informed by the manufacturer. And quite amazing tuner sections they are, as far as FM and stereo FM reception are concerned. Since the FM front end uses an FET transistor as an RF amplifier, we question the wisdom of having incorporated the "Local-Distance" antenna attenuator switch on the rear of the set. In our listening situation, we were never bothered by overload or alternate channel interference, despite the not-too-impressive alternate channel selectivity specifications of the receiver. Of course, others close to strong local stations may find this feature useful but it seems to us to be just another switch which the customer may inadvertently leave in the "local" position, resulting in extremely reduced sensitivity (and a possible needless service call).

We logged over 48 "listenable" FM stations, using a 4-element directional outdoor antenna and a rotator. Some 20 of these were received in stereo, and we found the "stereobeam" indicator to be positive in its indication—never lighting on interstation noise. Calibration was accurate, and there was no significant evidence of drift even after several hours of use. The circuitry does not employ any A.F.C. by the way.

AM reception was adequate though sensitivity seemed a bit lower than that in other sets we have recently tested. The serious AM "DX'er" would probably want to avail himself of the external antenna provisions which come with this set. Alignment and calibration on AM were perfect, however, and the tuning meter is active in this service as well as in FM.

Fisher's entry into the "under $200.00" receiver market should be a welcome bit of news for those budget-minded beginners or even seasoned audiophiles who have always "wanted a Fisher" but could not afford one. The introduction of the Models 201 and 202 by that company is not likely to mar their "quality" image, as they have certainly built in about as much value for the price as anyone could. *L.F.*

Check No. 132 on Reader Service Card

ADDENDA

Metrotec Frequency Equalizer Profiled April, 1971

The following are additional performance figures for the Metrotec Frequency Equalizer, which were not included in the April, 1971 profile of the unit. Total harmonic distortion, less than 0.04 per cent at two volts output and less than 0.1 per cent at five volts output; intermodulation distortion, less than 0.12 per cent at two volts output with 7000 and 60 Hz signals mixed 1 to 4; both hum and noise and separation were better than 60 dB below two volts output.

Phase Linear Seven-Hundred- Watt Amplifier

MANUFACTURER'S SPECIFICATIONS:
Power Output: Greater than 350 watts/channel, both channels driven, into 8 ohms, 0 Hz to 20 kHz. **Power at clipping:** Typically 450 watts/channel into 8 ohms; 730 watts/channel into 4 ohms. **Harmonic or I.M. Distortion:** Less than 0.25%; typically less than .01%. **Frequency Response:** 0 Hz to 250 kHz, direct-coupled inputs; 10 Hz to 250 kHz, normal inputs. **Sensitivity:** 1.15 V for rated output. **Hum and noise:** Better than 100 dB below 350 watts. **Input Impedance:** 100 k ohms, normal input, regardless of input level control position; 10 k ohms direct-coupled input, level controls bypassed. **Power Requirements:** 122% of maximum rms signal power output. Standby power is 55 W. **Controls:** Independent front-panel level controls, rotary power switch, input-mode selector switch. **Dimensions:** 19 in. wide, 7½ in. high, 10 in. deep. Bolt spacing will accommodate standard rack mount. **Weight:** 45 lbs. **Price: $749.00.** Cabinet available. Three-year warrantee. Phase Linear Co., 19555 23rd N.W., Seattle, Wash. 98177.

Each of us has experienced, at some time or another, the annoyance of a breakup of our amplifiers on an unexpected high-level signal, such as when a soprano hits her high C near the end of an aria. Whenever this happens, we learn to cringe every time this same passage appears, and it's all due to failure of an amplifier to handle the enormous momentary burst of power for that one note.

This never need happen again, for now there is the extremely powerful Phase Linear amplifier with its seven-hundred watt capability, *rms.* And it doesn't clip until it encounters a peak of around 450 watts. Not that it will put out 350 watts continuous for an extended period of time, although it might with fan cooling, but no amplifier is likely to be operated at maximum power for a long period—at least not for audio signals. But when the enormous reserve of power is needed, the Phase Linear is capable of handling practically anything you care to feed it. Should be a good background music amplifier for a rock session.

Description

The Phase Linear amplifier is constructed on a heavy aluminum chassis fronted by an anodized aluminum panel on which are mounted two large VU meters, illuminated by pale blue lumiline lamps under each one; the two input level controls, a power switch, and two pilot lights—one indicating when power is on, and the other indicating when it is off due to overheating. Power is automatically shut off when the output transistors reach temperatures exceeding 70 degrees C, and when they have cooled down sufficiently, power is restored and the amplifier operates again.

On the rear of the chassis is the enormous power transformer—2500 watts capacity—and four heat sinks, each consisting of two fins 4 in. deep by 6¾ in. high. Each sink mounts four PL-283 output transistors, a total of sixteen in all. Since the collector voltage is of the order of 100 the output transistors are covered by perforated metal shields. Along the rear of the chassis and adjacent to the sink farthest from the power transformer is the terminal section which mounts four phono input jacks, four binding posts, a switch for selecting normal or direct-coupled inputs, an a.c. receptacle which might be used for plugging in a fan, and five fuse holders—two for each channel in the supply lines, and one for the a.c. line. The silicon bridge rectifier is rated for 600 peak inverse volts at 25 amps.

The rest of the circuit uses 20 transistors, including 2 ICs, but in the absence of a schematic, we are unable to describe the circuit further. Suffice that it is direct coupled to the output and can be direct coupled to the input for amplification down to d.c. The d.c. supply to the amplifier is filtered by two 9800 μF, 100-volt capacitors.

Circuitry

Our first problem was to find a load capable of dissipating 350 watts per channel, since our regular test load panel will accommodate 50 watts/channel at 4 and 8 ohms, and only 100 watts at 16 ohms. Consequently, we secured six 25-ohm 100-watt adjustable resistors and paralleled them in two sets of three each, finally adjusting one so the actual load was 8.0 ohms at the end of the three-foot cables feeding the combination. This resulted in the desired wattage capability, but it also resulted in a measurable inductance in the load, which is a condition strongly to be avoided. Our usual practice is to get a resistor of four times the desired value and center tap it, then connect the two ends together. This quite effectively eliminates any inductance in the resulting load, but since we did not build up this load in the prescribed fashion, we ended up with a load

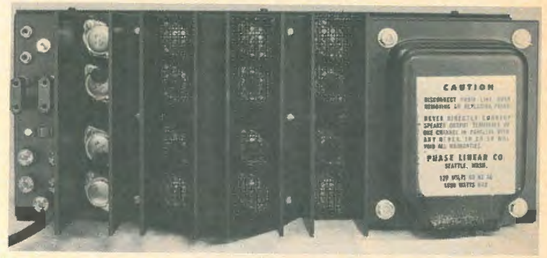

Fig. 1—Rear view of the amplifier with one protective perforated metal shield removed from one group of transistors. All input and output connections are made at the left end of the unit.

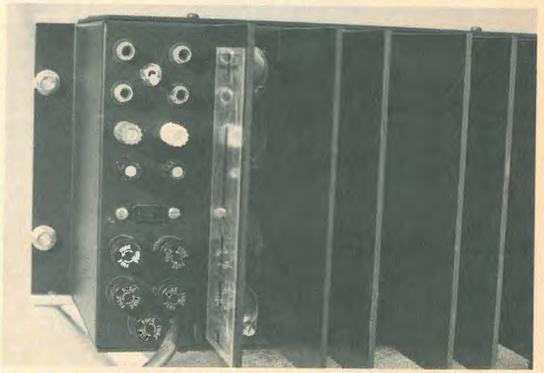

Fig. 2—The terminal panel with normal inputs at top, direct inputs immediately below, together with selector switch. Then come the four heavy-duty binding posts, an a.c. receptacle, four d.c. supply fuses, and the a.c. line fuse and line cord.

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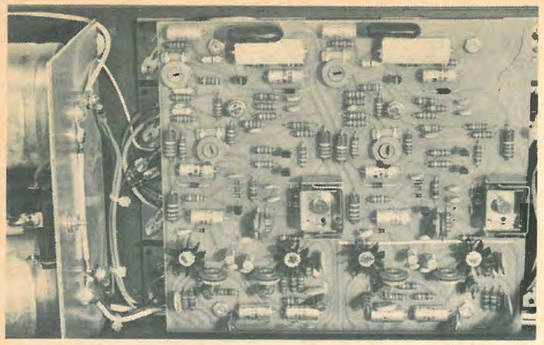

Fig. 3—The circuit board is neatly laid out on glass epoxy laminate for its permanence and high insulating qualities.

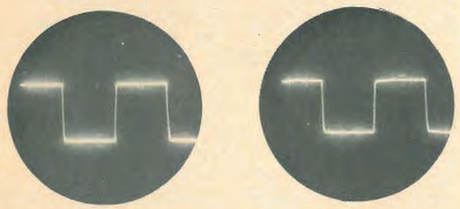

Fig. 4—Left, a 10 kHz square wave with normal load, and right, the same signal fed into a load consisting of 20 μH in series with the normal 8 ohms paralleled by 2 μF. Note that there is only the slightest difference at the leading edge of the latter pattern.

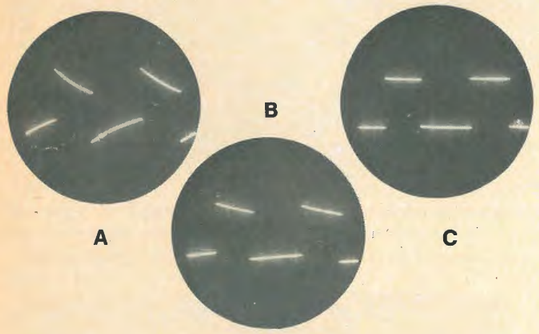

Fig. 5—Three versions of a 20 Hz square wave signal. A, normal input, with signal fed to a.c. coupling to scope; B, direct input, with a.c. scope input, and C, direct input with d.c. coupling to scope.

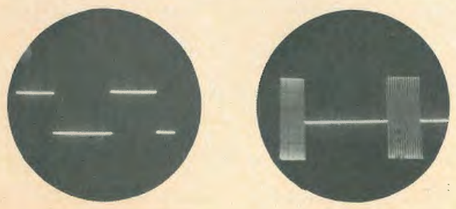

Fig. 6—Response to 1000 Hz square wave at left and tone burst of 20,000 Hz signal at right, both at a level of 50 watts.

having an inductance of about 250 μH—far too much for a wide-range amplifier. We should have obtained six 100-ohm resistors and followed this procedure, then paralleling three together for approximately 8 ohms, which could be obtained accurately by tapping down on one slightly.

However, using this 8-ohm, 300-watt load on each channel, we did perform the usual measurements of power output, and we found that the 350 watts per channel was obtained easily with a distortion of less than .04 per cent, which is as low as we can go with present equipment. Similarly, IM measured at less than 0.15 per cent. Then with a scope across the output of one channel, we increased the input signal until we saw a flattening of the tops of the sine wave, indicating clipping, and at this point we measured an output of 62 volts, which works out to be 480 watts per channel. Sixty-two volts across 8 ohms represents 7¾ amperes, which is a lot of current in *any* audio circuit, and the load resistors got hotter and hotter.

The manufacturer's circuit description states that the amplifier consists of two totally direct-coupled linear power amplifiers combined to form a single dual-channel unit. The output transistors are high-current, high-voltage, triple diffused silicon types arranged in a quasi-complementary format and biased for true Class B operation. The required bias current is carried by the driver transistors only, resulting in circuit efficiency which approaches the theoretical maximum. Bias control is accomplished by a bias regulator consisting of three voltage-reference diodes, a regulator transistor, and temperature-compensating circuitry.

The low-level stages consist of two complementary differential pairs, each pair providing voltage gain, while the second also provides voltage-level shifting to accommodate the predriver requirements. An emitter-coupled a.c. input stage is provided which blocks any signal appearing at the amplifier input for a brief period immediately following turn-on. A rear-panel-mounted switch connects the input signal direct to the first stage beyond the volume control when extremely low-frequency operation is desired.

The output terminals accommodate dual banana plugs which minimize the chance of a shorted output lead, and instructions specifically warn against any shorting of the output terminals

Performance

We made the specified IHF amplifier tests for stability which consist of operating the amplifier with no signal input and with no load, with 8-ohm loads, and with a load of .08 ohms on each channel, monitoring the output with a 'scope. In addition, loading with capacitive values from 100 pF to 10 μF, and with inductive loads from 10 μH to 1 H was observed, and in no case was there any spurious oscillation.

The specified load, according to one electrostatic speaker manufacturer, which simulates the electrical characteristics, consists of 20 μH in series with the normal resistive load of 8 ohms in parallel with 2 μF. For this purpose, we prepared a 100-watt load in the manner described previously, using two 50-watt, 75-ohm resistors, centertrapped with the ends shorted together resulting in a load of 9.26 ohms (½ × 75/4, with some shorting of turns on the resistor by the tapping to result in the 9.26-ohm value instead of the 9.375 which would be expected). The inductance of this load was measured and found to be less than 0.1 μH, which is essentially non-inductive.

We then applied a 10-kHz square wave and observed the output waveform, which is shown in Fig. 4 along with the same 10-kHz square wave, both at a 10-watt level. Note that there is practically no difference. Switching to a 20-Hz square wave, we observed the output with the signal fed to the normal input jacks, with the result shown in Fig. 5-A. Feeding the same 20-Hz square wave to the direct input jacks produced the result shown in Fig. 5-B. All of these figures were made with the oscilloscope switched to the a.c. input; switching to d.c. input provided the square wave of Fig. 5-C, which is essentially identical to that of 1000 Hz, Fig. 6.

There is no need to present a frequency-response curve of the amplifier, since it is perfectly flat from d.c. to 100 kHz, the limit of our audio generator. THD remained below .04 per cent from 20 to 100,000 Hz, and IM, using 7000 and 60 Hz mixed in a 4:1 ratio was also lower than specifications, actually measuring 0.15 per cent, with all measurements made with both channels operating and at the 350-watt level on each. Similar measurements made at a ¼-watt level gave measurements well below our measuring capabilities. Hum and noise figures were also well below anything we have encountered before, better than 100 dB below the 350-watt/channel rated output.

Listening tests

With this tremendous power available, we were chicken about connecting our speakers to the amplifier so we followed their instructions and put 1-amp. fuses in each speaker lead. After blowing out a few in trying to approach the sound level we normally get from our puny 60-watt/channel home amplifier, we finally connected a 50-watt, 1-ohm resistor in series with the 300-watt 8-ohm load-resistor assembly, and connected the speakers across the 1-ohm resistors in each channel. This way, we could assess the quality when the amplifier was working at full output. At 350 watts, the output signal voltage is approximately 53, and with this signal applied across the 8-ohms in series with the 1-ohm resistor paralleling the speakers, we were putting about 6⅔ volts across our speakers, and this results in about 5 watts across the speakers, which is still loud enough to judge quality. This, by the way, is how any super-power amplifier should be connected for listening tests, since one certainly cannot put 350 watts into any practical loudspeaker, and yet one wants to be able to hear what the amplifier sounds like when operating at capacity.

To all of this, all we can say is that the amplifier is everything claimed for it, as far as we can determine. We admit that we took every possible precaution with the listening-test lashup, continually praying that the 1-ohm resistor wouldn't open-circuit. Reproduction was all anyone could possibly want as far as quality was concerned, and we wouldn't hesitate to recommend the Phase Linear amplifier to anyone who wants—and can accommodate—its enormous power capacity. *C.G.McP.*

Check No. 133 on Reader Service Card

Stanton Mark III Isophase Electrostatic Headset

MANUFACTURER'S SPECIFICATIONS

Frequency Response: 20-18,000 Hz ±2 dB. **Sensitivity:** 2 V input at 1000 Hz produces 100 dB SPL. **Linearity:** Within 0.1 dB over SPL range of 20 to 125 dB. **Harmonic Distortion:** Less than 1% at 115 dB SPL. **Ear piece dimensions:** 5" high x 3¾" wide x 2½" deep over cushion. **Weight:** 15 oz. including headphone cable.

POLARIZER: Source Impedance: Designed to work from 4-, 8-, or 16-ohm speaker output terminals of any amplifier of 10 watts rms rating, or higher. **Power Requirements:** 105-120 V a.c. 50-60 Hz, 4 watts. **Dimensions:** Unit, not including front panel: 2¾" high x 4¾" wide x 7⅝" deep. **Weight:** 5½ lbs. **Price:** Headset with Polarizer, $159.95; Second Headset, without Polarizer, $75.00; Two-Headphone Adapter, $9.95.

Stereo headphones are practically *de rigeur* in any modern high fidelity installation, and audio buffs are becoming more and more critical of the response of their headphones as compared to their favorite speaker systems—they are beginning to expect the same quality of response in both.

Electrostatic loudspeakers have long been recognized as ideal, but in order to reproduce low frequencies well they had to be large when radiating into free air. This problem does not exist with electrostatic headphones, and their response can easily compare with that from the finest loudspeakers, with the added advantage that the sound is more closely coupled to the ears, giving a greater sense of realism to most listeners.

The Stanton Isophase phones were not available to us when we made the series of tests which resulted in the roundup of stereo headphones in the December issue. Consequently, we recently obtained a set and gave them the same sort of measurement and listening tests as were given to the others.

The headset itself consists of a pair of earpieces mounted on an adjustable headband with a universal-joint type of connection which automatically adjusts them for optimum fit. A detented knob on the top of the headband permits the user to adjust for size and pressure to practically any desired degree. As with all electrostatic transducers, a polarizing voltage must be provided, and this is done in a separate unit known as the polarizer. It contains the step-up transformers necessary to increase the signal voltage by a factor of about 100 to 1 in order to drive the very high capacitive impedance of the transducers, and in addition, a power supply for the high-voltage, low-current requirements of the units. This voltage is about 1000, but the current requirement is minimal, since there are no conductive elements between the "plates" of the phones, and the only current is that due to possible leakage between the diaphragm and the rigid conductive screens which serve as the two outside "plates" of the capacitor. The whole principle of electrostatic transducers was covered thoroughly by George Tillett in the March issue and need not be repeated here.

Because of the limitations of movement of the diaphragm, maximum signal must be limited by some workable means. Fuses are inadequate, since the peak potentials between adjacent elements in the transducer are what govern the required limitation, and fuses are simply not fast enough. The circuit designed

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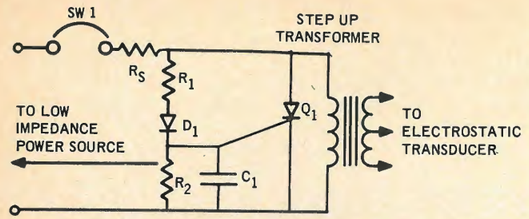

Fig. 1—Protective circuit.

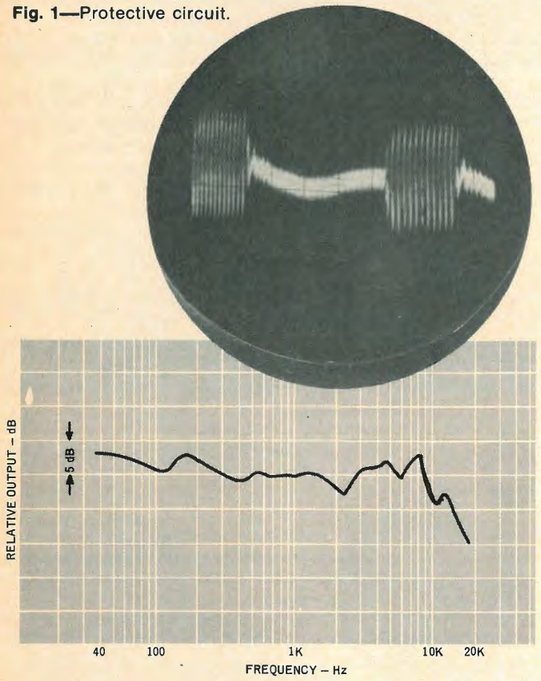

Fig. 2—Frequency response. The scope photo is of a 4000 Hz tone burst on the headphones as picked up by an artificial ear and an AKG C-451E condenser microphone.

to limit continued high signal levels yet still pass occasional transients consists of a circuit breaker followed by a series resistor in series with the primary of the step-up transformer. Across this primary is placed an SCR which is triggered by the voltage developed across a capacitor which is charged by a diode in series with a resistor across the primary. A resistor across the capacitor keeps the charge drained off unless abnormally high signal peaks cause the capacitor to be charged rapidly to the firing point of the SCR. Once the SCR is fired, the signal circuit is effectively short circuited, causing the circuit breaker to open. Thus are provided two possible forms of protection—one, the SCR, which provides immediate protection, and the second, the circuit breaker, which provides complete protection with the advantage of being resettable by the user simply by pressing the reset button, which is located on the front panel of the polarizer. The step-up transformer, the polarizing supply which furnishes around 1000 V d.c., and the protection circuit are all contained in the one package. In addition, a speaker/headphone switch permits the signal to be fed to the speakers in the normal manner when desired or to be cut off when headphone-only listening is wanted.

The polarizer unit is connected to the four output terminals of the amplifier or receiver and plugged into a convenience outlet to furnish the a.c. supply, using the nine-wire cable attached to the polarizer. Four wires connect to the receiver for signal inputs, and a fifth is connected to ground—practically any screw on the receiver chassis if a ground connection is not provided. Along the cable is a speaker connection box with four spring-loaded, color-coded binding posts to which the speaker leads are connected. These four additional wires make up the nine in the cable.

The headphones proper plug into the front of the polarizer in a 7-pin socket of the DIN type, using only five of the seven pins. Two leads are required for signal circuits for each channel, with the polarizing voltage being fed to the diaphragms, thus accounting for the five leads. The cable is 10 feet long overall, with the split to the individual earpieces at 18 in. from the phones, allowing for comfortable wearing. The junction is molded so as to offer a neat appearance as well as excellent insulation from the 1000-volt polarizing voltage. While this may seem to be a high voltage to be brought so close to the listener, it must be remembered that the 1000 volts appears ahead of the 4.7-Megohm resistor that serves as a filter, and a direct short at the socket on the polarizer would result in a current of only 60 microamperes which is well below the current described as being dangerous and well below the minimum shock hazard level.

Performance

We made our usual tests, using an artificial ear and a graphic recorder for the frequency run, together with a square-wave generator driving a loudspeaker near the phones when they were on the artificial ear to determine the isolation to external sounds. We do not claim that our artificial-ear measurements are absolute, only that they are comparative to those which appeared in the December, 1970 issue, since all the measurements were made on the same equipment. Similarly, we could not reach the isolation claimed by the manufacturer of 45 dB, but we do not know what method was used to make that measurement. We did, however, measure sound isolation from a 400-Hz square wave at better than 25 dB, which is excellent—far more than necessary unless one were recording a rock group in the same room with the microphone and recorder. Under those conditions, an isolation of better than 90 dB would be useful!

But it must be noted that the Stanton Isophase phones are very smooth over the range from 40 to 20,000 Hz, showing a variation of ±3 dB from 40 to about 10,000 Hz and only down about 10 dB at 20,000. In making measurements of this nature, only the tiniest variations in the artificial ear can cause relatively large variations in readings. The really important "proof of the pudding" is in listening, and here the Isophase showed up as superb. If one were ever skeptical about the use of phones, these should cure him. Lows were solid like those from a large theatre-type speaker system, and highs were smooth and silky, with no raspiness and no harshness. In addition to sounding so good, the Isophase headset was comfortable to wear, even with glasses, for a long period of listening. The kid-like vinyl covering for the circumaural foam pads was as soft as a maiden's kiss—one of those things you can't hardly ever get any more. Sure, we kicked out the circuit breakers several times, but we simply wanted to see how loud the phones would play. Loud enough, certainly, and even louder than one would consider adequate for comfortable listening. Operation was restored immediately by depressing the circuit-breaker reset buttons on the front panel of the polarizer. On the whole, these phones were well worth waiting for. *C.G.McP.*

Check No. 134 on Reader Service Card

Sonic Research Sonex Model 100A Compensator

MANUFACTURER'S SPECIFICATIONS

Controls and Ranges: Lo Bass, maximum boost of 13 dB at 40 Hz; **Bass,** maximum boost or cut of 14 dB at 20 Hz; **Treble,** maximum boost or cut of 11 dB at 20 kHz; **HI Treble,** maximum boost of 13 dB at 25 kHz; **Lo Bass and Bass combined,** maximum boost of 25 dB at 40 Hz, and **HI Treble and Treble combined,** maximum boost of 25 dB at 25 kHz. **Dimensions:** 15¾" wide, 3" high, 13" deep. **Price: $229.00.**

Here's a nifty tone control unit, from Sonic Research, Pasadena, Texas, that's a little more useful than those usually found on most stereo preamplifiers. The reason it's more useful is that the hinge points are further away from the midrange, allowing modification of the frequency extremes when this is desirable without altering the midrange very much.

The unit has input and output phono jacks at the rear, as well as an a.c. receptacle in case you're short one at the preamp. Complete connections to tape recorder as well as preamp are made there. The front panel layout is neat and controls are well arranged. The walnut sides are removable, exposing more of the front panel for panel mounting into a cabinet or such.

Inside the chassis the electronic circuits are expertly constructed on three plug-in printed circuit cards, as shown in the photos. The power supply is on one card while the active circuits are divided between the remaining two identical cards—one for each channel. Five percent resistors and associated high quality components are used throughout. A neatly laced harness runs between the circuit card connectors.

Measurements

The results of our measurements, as automatically plotted using a graphic level recorder, are shown in Fig. 1. We used 0.25 volts at 1000 Hz as an input reference, resulting in a 4 volt output when maximum boosts are applied. Our curves look very much like the ones published by the manufacturer, except that ours show somewhat less overall range than specified. The nice part is that flat midrange. Both channels tracked within 1½ dB of each other. We found that 5 volts rms was the maximum output attainable before clipping at all frequencies. Harmonic distortion remained below 0.08% throughout the range with controls set flat. We found that to preserve waveform linearity in the high frequencies we couldn't crank up **both** the TREBLE and HI TREBLE controls all the way, but had to stop short, about ¾ of the way up. In use, we found this amount of boost to be far too much anyway, so consider the practical limit as not standing in the way at all. The signal-to-noise ratio measured 73 dB below 3 volts or 77 dB below 5 volts.

Listening Tests

We first hooked up the Model 100A to a high quality system and then to one of lesser quality, using varied program material

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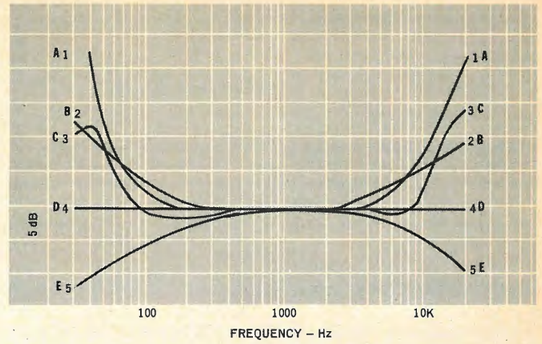


Fig. 1—Frequency response with various control settings. **A,** maximum Lo Bass, Bass, Treble, and Hi Treble; **B,** maximum Bass and Treble, rest flat; **C,** maximum Lo Bass and Hi Treble, rest flat; **D,** all flat, and **E,** minimum Bass and Treble.

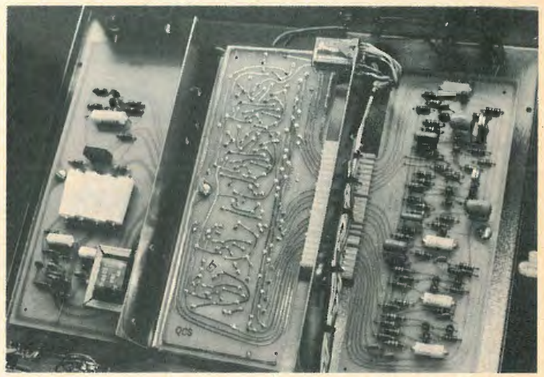


Fig. 2—Top view showing printed circuit cards.

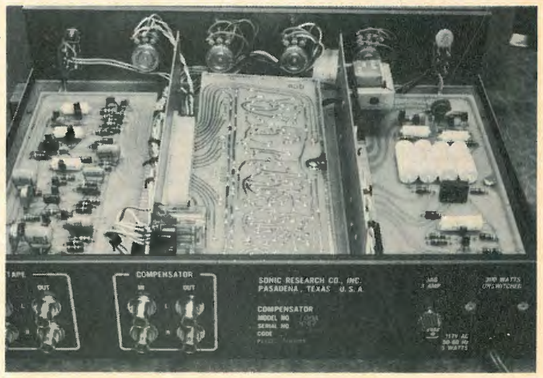


Fig. 3—Rear view of front panel showing ganged potentiometer controls.

Sonex Model 100A Compensator

(Continued from page 61)

in both cases. Of the four controls, the TREBLE had the most audible effect. Together with HI-TREBLE, it offered more flexible control over treble than the conventional treble control on our preamp. Whereas we rarely touch our preamp's tone controls, we adjusted this one many times, depending on source material. Regardless of the control setting, we could not hear any form of distortion attributable to this unit. There is no question that using these controls, as opposed to conventional preamp controls, we were able to improve frequency balance of various records and tapes, the "improvement" being determined by our ears. In most cases just a little boost or cut did it. A bit of HI-TREBLE control, for example, improved the sound of most trumpets except a few which were well recorded to begin with. The same went for percussion instruments.

When we tried the unit on a lower fi system, we noticed less of an effect when changing control settings, which is as expected. The HI-TREBLE control, for example, had no effect, nor did the LOW-BASS because there just wasn't very much information emanating from the system at those extremes. The bass and treble worked, of course.

While we find this device very useful in modifying program material and improving tone balance in general, we must qualify the manufacturer's statement that "the BASS and LO-BASS controls will improve the sonic balance of speakers which are weak in bass response." To be a good candidate for bass equalization, a loudspeaker must be capable of high acoustic output at low frequencies, otherwise when boosted it will merely be forced out of its linear operating region, resulting in severe distortion. There is no substitute for a loudspeaker with good bass response. The Sonic Research Model 100A, then, can only enhance a reproduction system employing a good loudspeaker.

This equalizer, as with other similar units on the market, is best used as a tone control unit which restores or alters, depending on the user's taste, the tonal balance of source material —not of the speakers nor of the room, but of the program source or phono cartridge only. In compensating for a phono cartridge which has a poor high or low end, keep in mind that restoring these extremes via equalization as opposed to improving the cartridge's own response (i.e. replacing it) degrades the resultant signal-to-noise ratio. In other words, a cartridge with a good high end will yield a signai-to-noise ratio audibly superior to the boost-equalized output available from a cartridge with a poor high end. Eliminating bright spots in the response is another matter and one which is well done by all equalizers and tone controls, provided the peak to be lowered falls within the operating range of the control.

We conclude that the Model 100A is a useful, though still limited extension of conventional tone controls. It can expand the user's ability to enhance the sound of the program by allowing him to alter the frequency balance. It offers an intermediate step between conventional tone controls of high quality preamps and more elaborate equalizers with controls one octave apart.

A.R.

Check No. 135 on Reader Service Card

Richard Freed

Vocal Fireworks

French Opera Gala. Joan Sutherland, soprano, with Richard Bonynge conducting l'Orchestre de la Suisse Romande and members of the chorus of the Grand Théâtre, Geneva. **London OSA-1286** (two disks), $11.96.

Great Operatic Duets. Placido Domingo, tenor, and Sherrill Milnes, baritone, with Anton Guadagno conducting the London Symphony Orchestra. **RCA LSC-3182,** $5.98.

JOAN SUTHERLAND has not been one of my big enthusiasms, and a two-record set designed frankly to showcase the virtuosity of Miss Sutherland or any soprano is not the sort of thing I'd be drawn to ordinarily, but I'd defy anyone to resist this "French Opera Gala" – anyone, that is, capable of taking in pleasure through the ear. The material itself is most imaginatively chosen, offering more than a dozen genuine "discoveries" bolstered by a handful of such surefire chestnuts as the "Doll Song" from *Tales of Hoffman* and "O légère hirondelle" from *Mireille,* and it's all carried off with the *panache* which is the only reason for bothering with it in the first place.

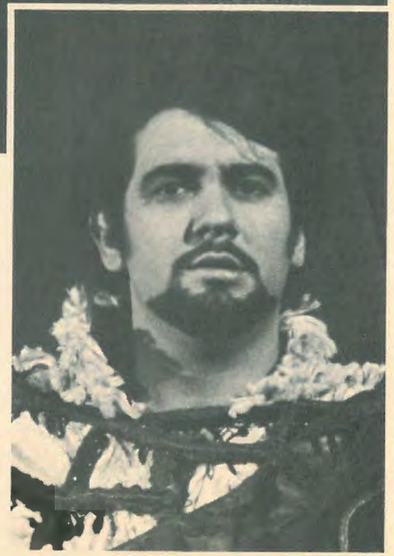
Richard Bonynge, of course, is expert at digging up the best of the forgotten virtuoso repertory for his wife and himself, and he may deserve the credit, too, for the thoughtful side layout, which does not group all the Meyerbeer together, or all the Gounod, or all the Offenbach, but instead gives us the respective selections in a sequence which provides the greatest variety and contrast. Side 1, for example, opens with a big, ravishing waltz-song from Offenbach's *Robinson Crusoe,* which is followed by an aria from Meyerbeer's *Dinorah* (but *not* the "Shadow Song"!) and then by a hauntingly beautiful performance of "Depuis le jour" from Charpentier's *Louise,* which strikes me as one of Sutherland's most successful essays in terms of *characterization* (and surely a splendid corrective after Montserrat Caballé's incredibly misjudged version on DGG). Then there follows a piece from Offenbach's *La Grande-Duchesse de Gérolstein* which is *not* the familiar "Ah! que j'aime les militaires!" (that one turns up on side 3), and the side ends with the sparkling "C'est l'histoire amoureuse" from Auber's *Manon Lescaut.*

If you don't insist on starting in with side 1, I'd suggest beginning with the infectious bolero from Lecoq's Le Coeur et la Main which opens side 4; this is music with no pretensions at all, just lots of glitter (including enthusiastically rattled castanets). It conveys at once the impression that Miss Sutherland, Mr. Bonynge and all their colleagues must have enjoyed themselves immensely making this album, and it becomes all but impossible not to be drawn into the fun. This side is filled out with an exquisite aria from Victor Massé's *Les Noces de Jeannette,* Siebel's air from Gounod's *Faust,* the Prayer and Barcarolle from Meyerbeer's *L'Etoile du Nord,* and another bolero, Bizet's "Ouvre ton coeur," in its original setting as part of *Vasco de Gama* (not an opera, but an ambitious choral work.)

In addition to the titles already cited, the set includes more Meyerbeer (an aria from *Robert le Diable* and the more familiar showpiece from L'Etoile du Nord), more Gounod (an aria from *Le Tribut de Zamora),* more Auber (from *Fra Diavolo),* more Bizet (from *Les Pêcheurs de Perles),* and an aria from Massenet's *Cendrillon.*

With determination, one can find things to fuss about. Sutherland's "Ah! que j'aime les militaires!" *(La Grande-Duchesse de de Gérolstein)* hasn't the mischievous, insinuating quality of Jennie Tourel's (reissued recently on Odyssey, in mono), and now and then her consonants simply tend to disappear

Sherrill Milnes



Placido Domingo

(most conspicuously in the nevertheless stunning selection from *Les Pêcheurs de Perles),* but what a treat—even (or perhaps especially) for a listener who is *not* a devotee of such stuff or its advocates—to be introduced to so many rarities that turn out to be so lovely, and so much fun! There is flair in great abundance here, real style, and also superb musicianship—plus sound in the same league.

The same qualities abound in the Domingo/Milnes collection on RCA, which also has one source in common with the Sutherland album: Bizet's *Les Pêcheurs de Perles.* The marvelous duet "Au fond du temple saint" from that opera is given a performance at least the equal of any that has preceded it on records—and there have been a few great ones. This is really an extraordinary piece of music, and this gorgeous realization of it is in itself enough to make one *have* to have this record, but the other seven items on it—all from Italian opera—are certainly no less attractive or impressive. They range from the exchange between Rodolfo and Marcello in the last act of *La Bohème,* to the confrontation between Enzo and Barnaba which ends Act I of Ponchielli's *La Gioconda,* to selections from four Verdi operas—the recognition duet in Act III of *I vespri siciliani,* the duet of Carlo and Rodrigo in Act I of *Don Carlo,* that of Otello and Iago in Act II of *Otello,* and those of Alvaro and Carlo in Acts III and IV of *La forza del destino.* Pretty strong stuff, and pretty grand projection.

Within a very few years, Domingo and Milnes, still quite young, have earned enormous recognition, and hearing them—either live or via recordings—leaves no need to ask why. Both are gifted with magnificent voices and exceptional taste in their use of them. I remember well the first time I heard Domingo: it was in his debut with the New York City Opera, as Pinkerton, and I was simply overwhelmed to find myself enjoying *Butterfly* so much. Here was a tenor, by God, who was also a real *actor,* and who was as natural and convincing in the latter sense as he was thrilling to hear in the former. A few months later I heard Milnes for the first time, as Marcello in *Bohème* at the Met—with the same reaction, which has been repeated and intensified with everything I've heard from either of these two since then. There is a virile purity, an elegance, and a by no means contradictory *relish* in everything they undertake; to hear them together is a more than doubled pleasure. You don't have to be an opera buff to get a wallop out of this record, and perhaps there is even something to be said for laying in a supply against the day when it becomes a collector's item. Æ

Quadraphonic Discs?

Edward Tatnall Canby

AS ANYBODY who reads the hi fi mags (and the technical journals) knows, quadraphonics has been gathering its energy slowly but surely for two long years. System after system has been announced and explored in public. Or the same (as a few of us know) in secret and behind the scenes. But, until now, without major issue, though RCA's Quad-8 cartridge* has in fact been launched for some time now and may make another billion dollars. By *major* system, though, I mean a system that *includes* the LP disc. The disc is not yet dead! Without a disc, four-way stereo has only been a specialty, as two-way stereo was before it blossomed onto disc in 1958.

The reason there has been no disc until now is because of an agonizing indecision on one vital point—on every level of thinking from corporate finance all the way to the aesthetics of recording technique—and that is, whether four-channel stereo must be literally faithful to four original master tracks on tape, or whether it may be transmitted by a less precise but more useful encoding process, via the two present channels of the audio media. Including of course as the vital element the LP disc. The problem, then, is basically "to disc or not to disc."

Either we have a stereo disc in four channels (compatible of course) or we don't. That has been the point of decision. But the real problem has been—to encode or not to encode. That was the big question.

I have been witness to quite a bit of the agony that has been part of this indecision. I've seen faces grey with worry, just because of it. I've seen shining confidence turn to dismay. And I've seen so much ingenious technical double-play, all of it fully justified, that I am no longer surprised at anybody's new black box for converting two channels (or one or three or 32) into four. There's a new black box for this purpose every few weeks currently, and all of them are spin-offs of the basic problem, which is how to convert the audio industry—necessarily spearheaded by the LP disc—to a useful four-channel operation. No LP disc, no real conversion.

*Now known as Q-8.

Well—these black boxes have been telling you—even if we never did get a four-channel disc, that you can still have fun and games on the side. The fact is that you can "decode" your present stereo material into four semi-synthetic channels with considerable sonic impact, liberating the extra information already present in most stereo recordings but undetectable in a spatial sense via the two-channel reproduction. They are right. You can! And this is significant. Even the ultra-simple, no-cost Dyna system (as per my earlier account) adds remarkable interest to many recordings via only one extra speaker and no black box at all. And this without the slightest pretence of *literal* faithfulness to the original space.

Do we need spatial literalness? We can use it. But it isn't the essence. This is the new idea. And it is not very different from the message of two-channel stereo, which is not literal either. When you come down to it there really isn't any literal original, even in classical music. Does there have to be?

Each black box has its own special coding-decoding system, sometimes secret, sometimes, so to speak, exposed for all to see. But what strikes anybody looking in from the outside is that all of these are basically related on an intimate and technical level; their merits are being thrashed out with immense vigor all over the place. They are so closely related that in plain fact you can send one black box's product through another system's decoder and come out with four channels which, though zany, are likely to be thoroughly enjoyable! The human ears really aren't that hard to please. Any four-channel surround commands more of their attention than any two channels, up front, other things being approximately equal. That is the message we're all trying to get over.

The long gestation period has been technically fruitful. With so much ardent discussion going on, each of these coding systems has been hashed over, compared A-B with others and with master tapes, tried again, tinkered with and adjusted, until each is by now developed to a pretty fine point of perfection, in its own way. And if I am right, in a general sense the various systems have been slowly approaching one another, because certain conclusions are technically inevitable, once you get working on the problem. I have a fair layman's idea of what they are but this is no place to get into the algebra and phasing of it. Suffice to say that the motivating differences are, in the main, economic ones. One can oversimplify the coding, for a too-rigid and mechanical result that doesn't go far enough (though maybe it's cheap). And all too easily one may get over-sophistication—too much ingenuity, too much circuitry, too many tricky adjustments. Which leads to confusions, unreliability and—worst of all—expense.

Without going further, I suggest that the three-speaker Dynaco system, though not intended for commercial exploitation, represents one extreme and the original Scheiber system might fairly represent the other. All of the rest fall in between, in terms of simplicity versus sophistication. You could play a Scheiber-cut disc into a Dyna system and come out with a very pleasant sound.

The trend of present thinking, then, is not hard to see—and hear. Increasingly, it is evident that we do not necessarily need a literal four-channel transmission system, four wholly discrete channels from start to finish, in order to make use of the power of four-channel sound reproduction.

As this conviction has grown on us, this last year or so, we have been approaching another of those nobly con-

structive compromises that have always graced the audio world. We didn't necessarily need a perfect piston action for our loudspeakers, much as it seemed theoretically desirable. We didn't require a perfectly tangent phono arm for our disc records, though that remains a realizable ideal to this day. We settled for less than two totally discrete disc channels when we converted to disc stereo, even though tape gave them to us. Necessity, they say, is the mother of invention—otherwise known as useful compromise.

And so the sequence of events follows the traditional pattern. Given acceptance of the idea of useful compromise, what next? Next, with the inevitability by which spring follows winter, comes the season of "have your cake and eat it too." How *nearly* literal can we get, then, once we accept the idea of non-literal coding of two channels with information out of four? And there is our present situation.

The entire technical battle over encoding, during this past year and more, has been precisely on this score. And ingenuity has not yet finished its work. Now, already, we can code four channels into two, then decode them back into four channels, which though not exactly like the originals, are astonishingly similar. I have heard four of these systems in great detail, with that crucial A-B test against original discrete channels as a check. There is no question about it, the coding idea is at the point of really permanent usefulness.

Once the idea is accepted by all of us for commercial exploitation via present technology we can have all sorts of lovely new cakes and eat them too. For the coding system allows us really total compatibility within each "arm" of the audio complex of transmissions. Notably, of course, in the LP record. Your encoded LP will play back in four channels, if you have the required decoder plus the four-channel playback equipment. It will play beautifully as two-channel stereo. (If there are compromises, they are mainly headaches for the recording engineers, ahead of time; the public will never know the difference.) It will play just as well in the mono mode. Same thing if applied to present stereo cassettes or present reel-to-reel stereo tapes. It could as well be applied to 8-track cartridges, though this would cause no end of confusion with RCA's Quad-8 system, which uses four discrete tracks and plays only half as long as the standard stereo 8 cartridge.

And the same coded four-way signal—most important of all—can be sent out via *present* FM multiplex broadcasting. The encoding is within the existing bandwidth in two channels. The transmitter and the FM receiver don't know the difference. Again, all you need is the decoder and the four-way reproduction in your own home or automobile. Four-way signals of this sort are already on the air.

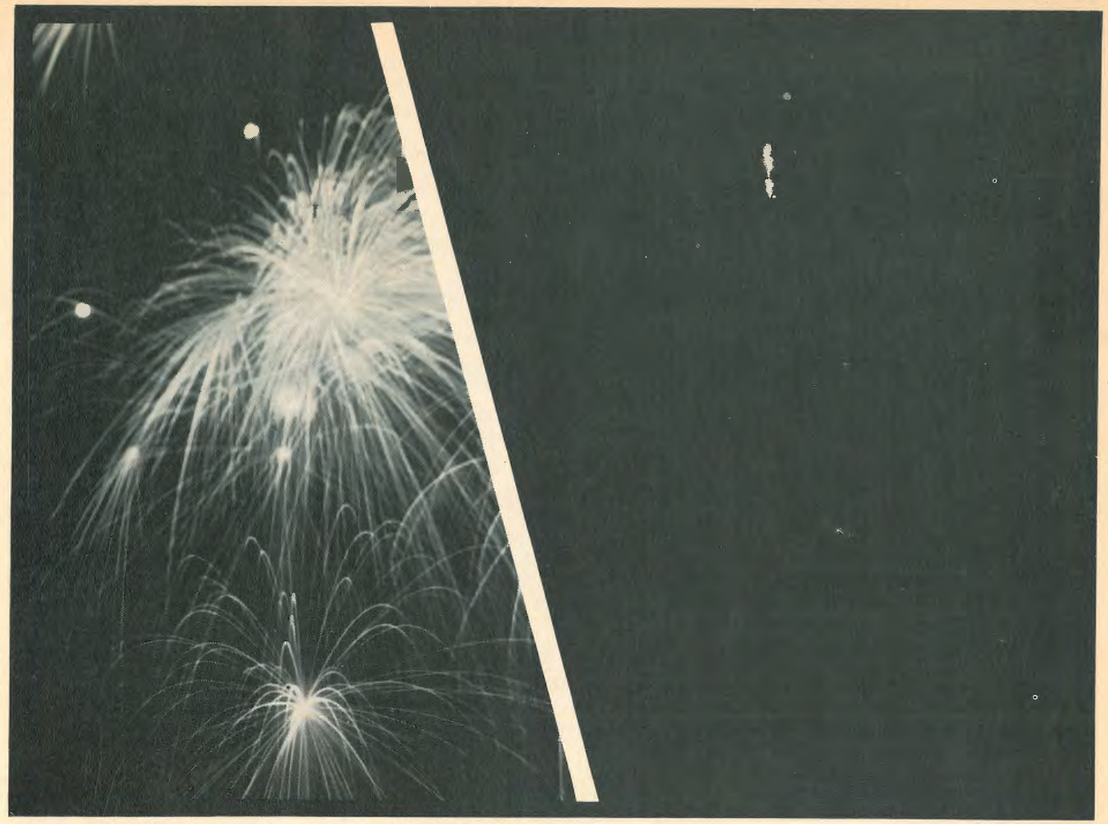
And so things have boiled down to the ultimate decision, *which decoding system?* We can use only one. One system must be accepted by all (though others may find side-uses, as above, to create assorted synthetic four-channel sounds out of present recordings).

By early spring, last year, it seems to me, the boiling had boiled about as far as it could usefully go. A decision had to be made. By force, manhandled via power politics. Or by sweet reasonability. One way or the other, the dice were ready to be cast. The only trouble was that nobody wanted very much to take the fatal step. Nobody, that is, but the smaller outfits, who were, alas, not likely to be the ones to swing the big deal.

But you can't be sure. Who got two-channel discs started? Remember? A little record label, Audio Fidelity, with a single disc cut to the 45/45 system, which precipitated the whole vast international rush into disc stereo by every big company in the world. I still own that disc and I like to look at it, just for kicks. (But the 45/45 system was big-company in its development, remember.)

This time the odds have been against the little companies, if only because too many of their new coding-decoding systems are competing for the big stakes. And also because, behind the scenes, the big disc companies without the slightest question have been trying out every system and, more important, have been working on their own, with all their resources. No big company likes to admit it has borrowed from little outfits. Even if it does, it's going to use its own label. But, more likely, it will do its own research and end up with its own variant. Thus—until the patent fights begin—we aren't likely to know whose ideas were in fact incorporated in whole or in part.

So we seem to be entering the four-channel age, albeit ever so reluctantly. Wouldn't it be nice not to have to bother! If you think so, as a consumer, be assured that every major record company agrees with you heartily, up in the corporate front offices! They hate to have to listen to their own engineers (who are, of course, enthusiastic for a change). If *you* have to invest new money, what do you think they have to do? If you think you'll be taking risks, what about them? That's our present situation. Well, at least the stock market is going up. Æ



Beethoven: Symphony No. 5; Schubert: Symphony No. 8 ("Unfinished"). London Philharmonic Orch., Stokowski. **London Phase 4 SPC 21042** stereo $5.98.

Shostakovich: Symphony No. 6; The Age of Gold (Ballet Suite). Chicago Symphony Orch., Stokowski. **RCA LSC 3133** stereo $5.98.

Debussy: Three Nocturnes; Ravel: Rapsodie Espagnole. London Symphony Orch., Women's Chorus of the B.B.C., Stokowski. **Seraphim S-60104** stereo $2.98.

Ever since he left the Philadelphia Orchestra in 1936, after 24 years there as its conductor, Leopold Stokowski has lived essentially the life of a free-lance—though en route he has founded several orchestras of his own (remember the one that was invariably billed "& his symphony orchestra"?) and has been attached to several others for relatively short periods. No free-lance conductor in history has remained famous for so long, if I guess right. Stokowski's first assignment was with the Cincinnati in 1909 (he was organist and choirmaster at St. Bartholomew's in New York before that) and he has been jutting forth his famous profile and waving the famed long-fingered hands (he never has used a baton) for the more than 60 years since. In April falls his 89th birthday, and there probably isn't an orchestra you can name—first-line, of course—which he hasn't guest conducted.

Typically, here are three recent Stokowski recordings, on three major labels. The RCA and London jobs seem to be new; the Seraphim is at least as recent as the early 60s—a moment ago in Stokowski's performing lifetime—since it is in stereo format. (In among my old 78s I have Stokowski recordings on Victor from the earliest electric period and on Columbia from the 1940s, with the All-American Youth Orchestra.) Like dozens of predecessors, these reveal a splendid conductor whose only fault is his ever-vivid flair for showmanship, his total avoidance of dullness. The man has a fantastic musical charisma—the sound is dramatized under his hands, sometimes into corn, more often into showy but intensely communicative re-creations, the fire of the freshly new work somehow brought back in all its excitement, all its special "effects" (and perhaps a few dreamed up by "Stokey" himself) shaped as though for the first time. Makes for exciting listening.

On London's Phase 4, the tired and overplayed Beethoven Fifth starts out with a positively commanding V-For-Victory and goes on through a lovely slow movement to the famed scherzo, played slowly and precisely—and then, into the ominously quiet build-up section at its end, all pizzicato strings, to plunge into the great Napoleonic blast of C major which opens the last movement with a sense of sheer triumph such as I haven't experienced for years and years. I have never heard this long sequence done with such convincing brilliance and drama—surely the very impact that was intended! The "Unfinished" too is played for all it is worth —*was* worth when it first burst on delighted ears in 1865 after 43 years hidden away and unknown. Mostly today these old symphonies get perfunctory, tired, or falsely energetic playings, full of sound and fury but minus conviction. Not here.

And who is to complain that an apparent lack of rehearsal time leaves the musicians sometimes baffled by Stokowski's unexpected twists and turns in tempo, falling out of step with him. Too bad; but the music's impact is not lessened, nor that of the excellent Phase 4, which brings out, once again, many interesting and useful musical details in these musical structures.

As for Shostakovitch on RCA, we realize with a start what Shostakovitch in his heydey really sounded like—the Sixth, in Stokowski's believing, skillfully Romantic presentation is more alive than I ever thought it could be again. An enormously disciplined performance (better rehearsals here?), taut but taking time for every bit of impact, and the same with the "Age of Gold" music, a valuable early addition to the Shostakovitch repertory. I've never heard its famous addled Polka set forth so perfectly.

Versatile is again the word for Seraphim's Nocturnes and Rapsodie Espagnole—another superb evocation, here of the late-Romantic Impressionist period, all warm color, shimmering orchestration, slithering harmony. The three Nocturnes are superb—the hypnotic stillness of motion in "Clouds," the flashing colors of "Festivals," and the haunting voices out of the sea in "Sirens," where two women's choruses spell each other to draw out a long line of melody seemingly with no breath for minutes at a time. Ravel's Spanish evocation, a drier, less endearing piece, is often tired in sound today but not with Stokowski to bring it to life.

As far as I know, while I write these words Stokowski is still with us. Let's hope he lasts until his 90th, only a year away. We can use him.

Performances: A,A,A Sound: A,A,A

Boulez Conducts Debussy's *Pelléas et Mélisande.* Shirley, Soederstroem, McIntyre, Ward, et al.; Orch., Chorus, Royal Opera House, Covent Garden. **Columbia M3-30199** (3 discs) stereo $17.98.

No doubt about it, opera has gone international for good. But, no doubt too, most popular operas are composed within a strictly national framework, for performers all of a kind. Never was this truer than in ultra-nationalistic France at the turn of the century, when the country was fighting to remove itself from the Germanic orbit of the Wagners and Liszts and Brahms.

So here we have Frenchman-international Boulez, recording the ultra-French "Pelléas" in London with a cast that reads zanily on paper. No wonder they list a language coach! Pelléas is George Shirley, from our Middle West. His Mélisande, that delicate wraith of a mademoiselle, is Elizabeth Soederstroem, straight from Sweden. Golaud, the other man, is Donald McIntyre, who hails from New Zealand via London and Wales. The grandfather, Arkel, is Scots. His daughter, Genevieve, has a French name, Yvonne Minton, but don't be misled; she comes from Australia. Even the language coach would seem to be of mixed ancestry—Janine Reiss.

(Continued on page 70)

Classical Record Reviews

(Continued from page 69)

If my ear is right, the only one of these who has caught the genuine French way of singing is the New Zealander, Donald McIntyre. The others betray their origins both in the unsubtlety of their French and, more important, in their styles of voice production—for French singing is of all "schools" the most special and different in its curiously white, nasal quality.

No good? Hardly that. Given the type of cast, the result is astonishingly well integrated. And given *this* opera, virtually one long French conversation, without arias, sung-spoken almost like a play with music, the Boulez shaping of the whole meaningful sound is remarkable. The opera gets over, if with less of that mysterious Impressionist quality that belonged in the notable all-French performances of earlier days. Boulez, after all, is no latter-day Impressionist. Better to call him an Expressionist, forthright, strong, outward. His is that kind of a "Pelléas."

The recording of the voices is beautifully natural, moderately close against the ever-moving, ever-discreet orchestral background. Columbia includes a mammoth Columbia-style book, full of mod-layout stuff—with the whole in three languages. Columbia's going international too.

P.S. Don't forget that the opera is based on a play by Maurice Maeterlinck (good Dutch name) who lived in Ghent, and the scene is a country of the Middle Ages called Allemonde, i.e. Germany. It's still an ultra-French opera.

Performance: B+ Sound: B+

Paderewski: Piano Concerto; Fantaisie Polonaise. Earl Wild; London Symphony, Arthur Fiedler. **RCA LSC 3190,** stereo, $5.98.

Henselt: Piano Concerto. Liszt-Lewenthal: Totentanz. Raymond Lewenthal; London Symphony, Mackerras. **Columbia MS 7252,** stereo, $5.98.

The major record labels have each their Romantic Concerto Specialist, the man who digs up old virtuoso pieces that ought to be brought back. Here's RCA's Earl Wild and, for comparison, Columbia's Lewenthal, recording with the selfsame orchestra a year or so back.

The Paderewski is really charming old stuff—hard to believe (for me) that this was composed by a pianist who was Big-Time when I first began in music. Wild has the required big sound and bigger technique but his manners, somehow, are gentle, his music sings whenever it can, and thunders benevolently when thundering is the thing. It is, quite often. The Concerto is youthfully buoyant, out of Vienna in 1888, the Polish Fantasy, full of sporting Polish tunes, is five years more mature but just as happily old fashioned. Fireworks for the piano everywhere, a fine RCA piano sound, never hard, and a beautifully tailored orchestral accompaniment by Arthur Fiedler—whose Boston Pops RCA can no longer record.

Lewenthal's piano is made of sterner stuff. He is predominantly the powerhouse sort of keyboard man, and Columbia obliges with a zirconium-plated, hardened-steel piano sound, accurate but not lovely. The Hanselt concerto, a Germanic work out of Russia, where Hanselt worked for 45 years, is very persuasively Romantic in its 1840 styling though—as Lewenthal points out in a 7-inch bonus record—there are strong hints of Rachmaninoff and such in its music, which influenced the later Russians no end. Hanselt was a thorough pro and his work flows as smoothly as silk but the stuff is not profound nor original, his great weakness being a weakness for sentimental, sanctimonious tunes, Mendelssohn decked out à la Chopin (or so we hear them). He hasn't the strength of such less fashionable once-unknowns as the Swedish Berwald.

Lewenthal's special edition of the showpiece "Totentanz" (Dance of Death) derives from the fact that Liszt made several versions of this work, with radical changes in between. Lewenthal has taken hunks of an earlier (and presumably withdrawn) version and patched them into the later and more familiar work for a showpiece to end all showpieces. The whole thing has that characteristic sinewy Liszt brilliance, dazzling, always teetering between profundity and banality, and to add a bit more of the same does no sacred harm that I can see. Gives Lewenthal more fireworks, more pianistic earthquakes and thunderbolts, to round out those already on hand. The bonus record explains the additions. (You'll have to take the pianist's musician-style voice in your stride; the pronunciation, of course, is "pyah-no.") The first side is a music-appreciation talk on Hanselt's themes, yet with some interesting comparisons of piano tricks as between Hanselt and other composing worthies, including Rachmaninoff.

Odd, by the way, to hear the same orchestra (and maybe the same piano?) recorded for RCA and Columbia at different times. Quite a different sound. Columbia's disc is louder, coarser, heavily grooved and on the edge of overload in too many spots, the piano without enough space around it to sound convincing with the orchestra. I liked RCA's job better. Moreover, the Columbia orchestral music is far less accurately played than RCA's Paderewski, a combination perhaps of insufficient rehearsal and a less meticulous conductor. The London Symphony plays for everybody but it can play well when it is given the chance.

Performances: B+, B- Sound: B+, B-

Voice of the Computer. (Mathews, Risset, Tenney, Slawson, Shepard, Pierce). **Decca DL 710180 stereo ($5.98)**

More computer music! Actually, you'd never know, if it didn't say so. This is what I like to call *concept* art, a product where the idea behind the method used is what matters, more than the mere result. We find concept art everywhere these days.

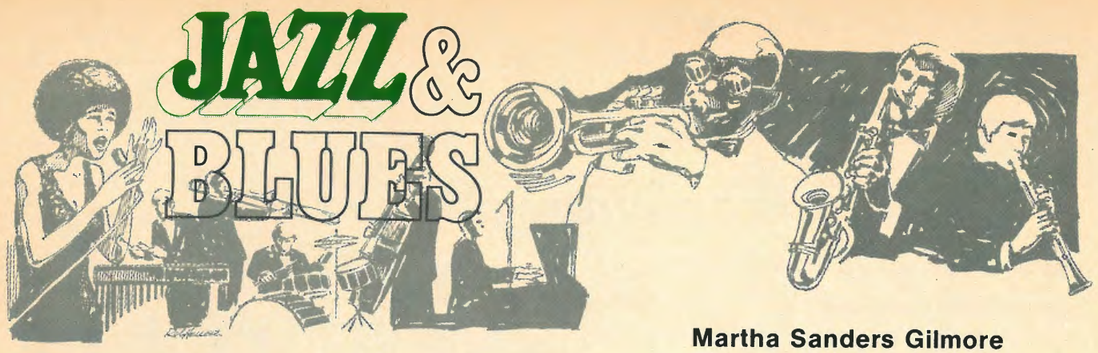
Thus the various items on this record might, offhand, seem to come from a tired and elderly synthesizer, perhaps the prototype before Mark I. The sound is generally woolly and monochrome, lacking crispness, the pitch is (deliberately?) shaky and "out of tune," the whole is, so to speak, immersed in a vague sonic song. The effects, pleasant enough even in smog, are not exactly startling, more often comfortably familiar in electronic terms. It's the way the pieces were put together that matters. The computers did them.

Lots of twirps, tweets, gurgles, slides, whooses, twangs, peeps, as per usual. Plenty of atonally dissonant counterpoint (admittedly suitable to the medium) and a great deal of organization, some of it available to the curious ear as well as to the eye that reads the program notes. In other words, a good standard job, in spite of the dull sound, with the usual admixture of semi-mysticism leavened by quite a bit of humor (not all intentional, I suspect). In one item a voice interjects words here and there between computer noises, adding up, like Burma-Shave, to predictable cliché (even if stylishly derived from the ancient Japanese): "Let's...go...for...a walk. . .out through the new-fallen. . . (guess what?). . .SNOW. . .oops!. . .'til. . . down. . .WE GO." Another piece was written directly on a picture tube via a light pen; the computer gave forth with the sounds. A debatably "new" device in another work is an endlessly descending/ascending spiral of tones that never seem to get any lower/higher. Bach used it in the 1700s, in his big G Minor organ Fantasia.

Performances: ?? Sound: C+

Canby's Capsules...

TITLE	CONTENT	SOUND
1812 Overture, Wellington's Victory. Philadelphia Orch., brass bands, Temple Univ. Choirs, bells, electronic cannon, Ormandy. **RCA LSC 3204,** stereo, $5.98.	2 in 1! The latest "1812" uses synthetic cannon, plus the usual bands, vast choirs, masses of bells. Beethoven's "Victory" is mainly the Phila., plus 100 cannon shots; not all potboiler stuff—much typical Beethoven. Vast performances, adequate verve and pep. Wot else?	D ! First electronic cannon blew my speaker fuse; fixed it with a safety pin. Very potent! But on most players will merely be a big smudge. Fancy 8-track recording (via 3M) and 18 mikes make a good mix of 250 musicians, bells and guns; natural dynamics overall, no hyping, a rather distant sound in both works.
Strauss: Sinfonia Domestica. Los Angeles Philharmonic, Mehta. **London CS 6663,** stereo, $5.98.	At the tail-end of his series of tone poems, this one was once reviled—for not being "Heldenleben"—now seems relaxed, skillful, moderately humorous; pleasant if lengthy listening. Nicely relaxed L.A. performance, just right for the unbuttoned mood.	Long time since I've heard such excellent ffrr-type sonics, even if via California. Characteristic accurately balanced closeup sounds, melded in golden liveness, bringing out much detail yet avoiding ungainly closeup distortions of musical meaning. Lovely.
Prokofiev: Four Portraits from "The Gambler"; Suite, "Love for Three Oranges"; They are Seven. Moscow Radio Symph. Orch., Radio Chorus Rozhdestvensky. Y. Yelnikov, tenor. **Melodiya Angel SR 40157,** stereo, $5.98.	More early Prokofiev, around 1920—done with the vividness of Russian rediscovery. "Gambler" is 1931 remake from 1915 opera; "Love" includes familiar snazzy Chicago-based music of 1921; "Seven" is a cantata out of "Rites of Spring" barbaric period before 1920.	Once again, that solid-bottomed, slightly dry, pot-bellied Russian sound, most impressive if still a trace grainy in the louder parts. Somehow, the Russian sound adds to the impact of Russian performance, Russian music, making these Melodiya discs unique in impact.
Tchaikovsky: Symphony No. 1 ("Winter Dreams"). Boston Symphony, Michael Tilson Thomas. **Deutsche Grammophon 2530 078,** stereo, $5.98.	A splendid portrayal of this big early Tchaikovsky, so seldom heard. A very expert piece of symphonic writing, if less memorable in content than later T. The young Thomas had the BSO in beautiful control—very good.	DG has put its knowhow into America's finest concert hall—they've got a huge, expansive sound yet with sharp separation and great sonic width. No harshness—all is smooth and lovely, the real sound of the Symphony Hall itself.
Radio Free Nixon. David Frye. **Elektra EKS 74085,** stereo, $5.98.	Wicked, wicked! The second Frye impersonation recording, this one based on fantasy of a Nixon private station and a series of take off air shows. Most satire is cruel; this is, decidedly. But what matters with Frye is that uncanny voice—Nixon, LBJ, the Hump, et al., to the very breath. (And Pat, and other females, via accomplices.) Everybody's in the act—Spiro, Rocky, Henry Fonda, Truman Capote, et al. I don't like the try for a pseudo-Nixon hit song ("My Way"). Pretty cheap. (It's out as a single.)	
Boulez Conducts Boulez: Pli selon pli. B.B.C. Symphony. Columbia M30296, stereo, $5.98.	"Fold on Fold"—this is the man who bosses our N.Y. Philharmonic now and his music might suggest where he may be taking the same. Phew! A vast, gamelin-like orchestra, jangles, blats, masses of clattery noises in horrendous complexity (but lots of color), a soprano who miraculously hits notes, high and low, miles apart—she evidently hears them okay, somehow. Unbelievable that this could be written down at all, even with much aleatoric freedom (improvising within specific limits). It's no language for you and me to understand but that doesn't mean you won't enjoy it as a sort of bath of sonic exuberance—filled with broken glass, super hi fi.	
Handel: Orlando. Sciutti, Bogard, Steffan, Greevy, Rintzler; Vienna Volksoper, Stephen Simon. **RCA LSC 6197** (3 discs), stereo, $17.94.	Another long-unheard Handel opera revived, excellent material for records as well as concert and (modified) state production. Odd: an amorous pentangle, two men and three women, unraveled in noble sacrifice. The men were castrati—contraltos here, only the balancing god-like Zoroaster is a male (bass). A rich and varied Handel score; good soloists make it vivid and fresh. But the faster music is driven rigidly by this conductor, who pulls the singers along with him, unmusically, marring much impact. The production was done "live" in New York with a different orchestra. (Handel Society)	



Martha Sanders Gilmore

Robert Pete Williams: Angola Prisoner's Blues.
Musicians: Robert Pete Williams, guitar; Robert "Guitar" Welch, guitar, and Matthew "Hogman" Maxey, guitar.
Songs: Levee Camp Blues, Stagolee, Electric Chair Blues, Prisoner's Talking Blues, Motherless Children Have a Hard Time, Black Night Fallin', Some Got Six Months, I'm Gonna Leave You Mama, and I'm Lonesome Blues.
Arhoolie 2011, $5.98.

Arhoolie Records, a name which brings to mind the field holler or hoolie, lived up to its name by issuing a fine, well-rounded collection of nine so-called prison blues, emerging from the talents of three inmates serving time at Angola, Louisiana's desolate, blues-struck state prison farm. A small firm located in Berkeley, Arhoolie specializes in folk and blues music.

Produced by Chris Strachwitz and Dr. Harry Oster, who wrote the very informative and extensive liner notes which helpfully include the actual lyrics, the album was recorded in 1959 and was originally released as Oster's Folklyric LP No. A-3.

It reflects three shades of blues as captured by guitarists with the complex and poignant style of Robert Pete Williams, the ironic, understatement of Robert "Guitar" Welch, and the rather intriguing and ear-bending polytonality of Matthew "Hogman" Maxey with his Western brogue.

Most outstanding and featured in six of the nine songs is Robert Pete Williams whose country blues lines not only wail out the gamut of the genre but venture far beyond traditional blues licks in a musically refreshing and soul stirring evocation of the blues, striking a superlative balance between music and message.

In "Prisoner's Talking Blues" Williams relates his fatalistic attitude toward death, spreading his message in round, full tones. A gentle guitar accompaniment rides along rhythmically in the background, ending unexpectedly on the second note of the scale.

A galloping staccato blues line in parallel fifths elevates "I'm Lonesome Blues" to a status which is nothing short of unique. Williams punctuates his lyrics with antiphonal asides, bowing to the power of suggestion by omitting words. His musical pulse races like the wind, his manner of delivery sincere, innovative and devoid of musically stagnant cliches. Insinuated quarter-tones lurk in the crevices of his art.

Hogman Maxey on 12-string guitar executes a rhythmic, lively "Stagolee," that familiar bad-man ballad most of us attribute to Lloyd Price but which, in fact, reaches back half a century. Cheerful, polytonal, Maxey sings in D and accompanies himself with a G chord, employing few changes.

Guitar Welch brings back the legendary technique of "thimble thumbing" in "Backwater Blues," wearing the neck of a small green bottle on his little finger. As if this is not enough, the arrangement behind his velvety voice, is embroidered with mediant 7th chords whereby the first tone of the scale is sharped, an unusual motif in the blues.

For a collection of blues with a prison theme, this batch of blues is amazingly diverse, treating such subjects as infidelity in love, pain, and loneliness, to the acute fear of the electric chair, despair of motherless children, and monotonous fate of the lifer.

Recorded in the tool room of Camp H of the Angola, Louisiana State Penitentiary, the sound reproduction is good, on the whole, though Williams' instrument was at times indistinct.

Arhoolie label virtually breathes an uncommercial approach, evidencing a historical interest in the blues form. Watch for future recordings in this series which will present surviving work songs and Negro convicts' spirituals.

Performance: A Sound: B+

Jimmy Smith: I'm Gonna Git Myself Together.
Musicians: Jimmy Smith, organ, orchestrations arranged and conducted by Johnny Pate.
Songs: I Know What I Want, Dock of the Bay, Uh Ruh, I'm Gonna Git Myself Together, Dirty Roosta Booga, Spill the Wine, Need Mo', and Sugar, Sugar.
MGM SE 4751, $4.98.

The incredible Jimmy Smith's concession to rock in this LP of eight tunes is constrained, constricted, and out of character for his usual ebullient and timeless improvisatory style at the keyboard. For the extremely talented Smith, who fairly opened the jazz world's eyes to the flexibility and jazz potential of the organ, is bound here by the shackles of rock's somewhat narrower limits, thereby producing an album which is neither fish nor fowl, musically speaking.

Although the orchestral arrangements by Johnny Pate are at times inventive and colorful, reflecting a healthy use of percussion as evidenced in "Spill the Wine," "Need Mo'," and "Dirty Roosta Booga," a real shouter, one is constantly subjected to cacaphony and voltage. It is not my intention to put rock down here. I merely object to the combination of rock and jazz in this particular recording which obviates a commitment one way or the other.

The musician at the Fender-bass who goes unnamed deserves praise for his efforts, however, and provides the entire set of tunes with a constant underglaze. A tambourine contributes light strokes to the canvas and falls right in against the drums.

Smith's gutteral intonations may be heard on five of the eight tracks. In "Uh Ruh," a 12-bar blues which is brief and to the point, he utters tongue-in-cheek monosyllables. The rather abrupt ending is pleasant in contrast to the often-used fade-out.

Smith's very own "I'm Gon' Git Myself Together" is a slow, sinuous blues—a fusion of rock with rhythm and blues. It stands as one of the more memorable numbers.

In "Dirty Roosta Booga," one of the most successful attempts in the set, the orchestra alongside Smith sprints forward to the finish like a turbine engine, ending double-time.

Smith eases into "Dock of the Bay" vocally, with no strain and a bit of resignation in his manner. It all bears a commercial ring and one is reminded of acoustics attendant to dances at the school gym.

Unfortunately, the sound throughout is a bit muddy and unclear although heavily amplified. Many times the rhythm section overcomes the sound of the organ.

Smith fans will probably agree that their "mojo" man can and has done better. Perhaps the rock vehicle is not a challenging outlet for him. He has merely strayed from his element here.

Performance: B- Sound: B-

Great Guitars of Jazz
MGM SE-4691 $5.98.

Nobody is going to dispute that there are fine guitarists at work on this album, not with cuts by Wes Montgomery, Kenny Burrell, Tal Farlow, Barney Kessell, Herb Ellis, Howard Roberts, and Oscar Moore. The problem is that these are re-issues of now rather-tired cuts, all at least five years or more older. Some of these will be recognized as classic performances: Kessell's *Crazy Rhythm* and *East of the Sun (And West of the Moon).* If you are a student of jazz guitar, this will probably be useful in comparing various techniques. **P.D.**

Performances: B *Sound:* B

Stan Getz Quartet: Sweet Rain
Verve Stereo V6-8693 $5.98.

It's good Getz, with Stan backed by a rhythm section composed of Ron Carter, bass; Grady Tate, drums, and Chick Corea, piano, who wrote the lead tune, *Litha.* Other tunes included are *O Grande Amor,* a Jobim and DeMoraes composition; *Sweet Rain, Con Alma,* and *Windows.* The album was recorded back on March 30, 1967 at Rudy Van Gelder's studios in Engelwood Cliffs, N.J. This was a year or two after the height of fascination with the Bossa Nova. Much of the influence is still evident in this album, but with Getz out front, it doesn't sound dated. This is extremely listenable jazz, warm, relaxed and highly lyrical. **P.D.**

Performance: A *Sound:* A

Audioclinic

(Continued from page 5)

measure. Therefore, this measuring process is used to surmount this difficulty.

Power measured under these conditions is Music Power, or IHF Power.

As far as I am concerned, the closer the IHF power comes to equaling the rms power, the better is the particular amplifier. There is no formula for converting IHF to rms power ratings because this is a function of the design of the particular amplifier. I prefer to look at the rms ratings where they are available. This, to me at least, is the more significant of the two ratings.

However, there are many who will disagree with my judgment in this case. We are now getting involved in an opinion area, and I don't think there is any way to decide this argument one way or the other.

Circuitry

Q. I have encountered a problem with a modification which I recently made to my stereo system. The modification involves placing auxiliary input jacks and a turntable on/off switch, plus an auxiliary/phono switch into a compact stereo unit—Zenith Model Y565W. The problem which has arisen is a very distracting, low-frequency hum which increases with volume control settings. At very high volume settings it becomes more of a combination hum and buzz. The hum can be minimized, but only slightly, by reversing the power cord in the a.c. socket. I suspect that the cause is improper grounding, but with my minimal knowledge of electronics, I am unable to rectify the situation. Shielded cable has been used in all of the wiring.

I have enclosed a rough drawing of the modifications which I made. (See Fig. 1.) The hum is present in either position of the auxiliary/phono switch.

I would also like to add a cassette deck some time in the near future. Therefore, I would like to include tape output jacks without major modification.

Can you be of help with my hum problem and with the addition of tape monitoring facilities?—Grey Pash, Lexington, Kentucky.

A. What you did electrically is fine and should have produced no problems.

It may be that your a.c. switching arrangements have been routed near the various shielded cables associated with the phonograph cartridge, the auxiliary input and the original input to the Zenith. Move the a.c. leads away as far as possible. That may solve the problem.

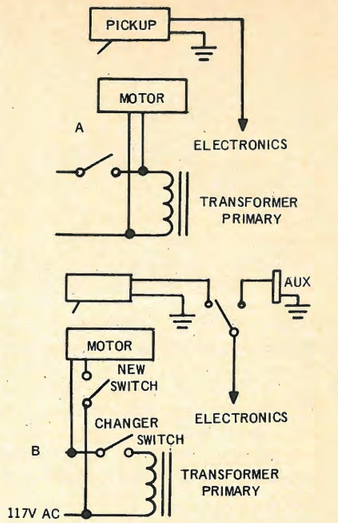


Fig. 1—Modifications to stereo compact record player. (One channel is shown)

You do not show how you grounded your various shields. I suggest that you use two-conductor cable for your wiring. The shields should be grounded at one end only. This point would be located near the input of the Zenith. The other end of the shield will not be connected. One of the conductors will be used to

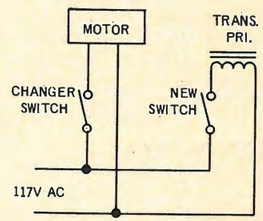


Fig. 2—Independent switching system for record changer and electronics.

carry the "hot" signal source in the usual manner. The other conductor would be grounded at the input ground and also at the connector. The connectors might have to be insulated from the chassis. By following this scheme, the shield does not act to carry signal. No differential voltage can appear from one end to the other, thus inducing hum into the "hot" conductor. I suggest that you use this procedure with all the shielded cables, those from the wipers of the added switch, those from the phonograph cartridge, and those related to the auxiliary input connector.

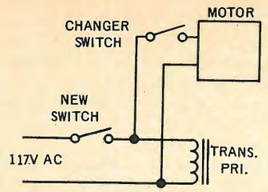


Fig. 3—Interlock switching between electronics and record player.

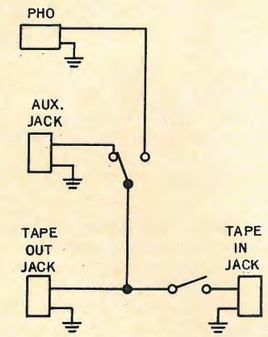


Fig. 4—Tape monitor switching system. (One channel is shown.)

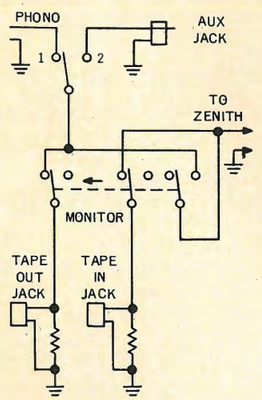


Fig. 5—Fail-safe tape monitor. (One channel is shown.)

There is something you did not ask about, but which causes me concern. This is the manner in which you set up your a.c. switching. It appears that in order to turn on the amplifier, you use the changer switch. When you actuate this switch, you are probably engaging the idler between the turntable and the motor shaft. If this is the case, even though the table is not turning, the procedure can result in flat spots on the idler wheel, leading to "thumps" every time the idler makes one complete turn. What I would prefer to see here is for the changer to be rewired so that the only function the original switch has is to turn the motor on and off, leaving the primary of the power transformer permanently turned on. However, your new switch would interrupt power to the electronics. (See Fig. 2.) By this means you would have independent control of the changer and the amplifier. You also could arrange matters so that the changer could not be actuated unless the electronics were turned on. That could be accomplished merely by having the changer switch feed the primary side of the switch you have added (See Fig. 3.)

Keep all a.c. leads away from signal leads. If this is impossible, run the a.c. in dual-conductor shielded cable, with the shield grounded. Take precautions to eliminate shorts. Use cable having heavy insulation surrounding each of the two inner conductors.

As to the problem of adding a tape monitor provision, the two wipers of the selector switch you have already added would be disconnected from the input to the Zenith's amplifier. These two wipers would go to the tape-in jacks, those which feed the tape machine's input. The tape recorder's output would go to a connector which would feed the input of the Zenith. At this point the only way signal can pass from the auxiliary inputs to the Zenith is by way of the tape machine. However, if you wish this feature defeatable, use a double-pole single-throw switch, wired in such a way as to short the tape-in and the tape-out jacks together. When this switch is open, these jacks will be separated and the recorder can be placed in operation. (See Fig. 4.)

Although this circuitry is simple, it can be improved on. Remember that when the tape monitor switch is closed the tape-in and tape-out jacks will be shorted together. If the tape machine happens to be plugged into the equipment, its input will be connected to its output. This will give rise to oscillation. If you follow the circuit of Fig. 4, you should disconnect the recorder before closing the "tape monitor" switch.

Figure 5 shows an improved circuit. This circuit is so arranged phat when the tapemonitor function is not required, the jacks are completely disconnected from the circuit. Thus, the tape recorder can be left plugged in at all times, instantly ready for use.

Take notice that some cassette machines do not enable the user to play through them. In other words, their output is not energized during the recording process. Rather, signal appears in the output only when a cassette is being played back. That would make the normal application of both Figs. 4 and 5 virtually impossible.

Prokofiev: Cantata for the 20th Anniversary of the Oct. Revolution. Shostakovich: The Sun Shines Over Our Motherland. Kiril Kondrashin conducting the Moscow Philharmonic and the RSFSR Russian Chorus, Ampex/Angel-Melodiya M40129, open reel, 7½ ips, $7.95.

Herewith the first recordings of these "patriotic cantatas," and it is a fairly safe bet that even the most avid devotees of the works of these composers were not aware of these large scale compositions. These propagandistic vehicles are typical of what composers, even of the stature of Prokofiev and Shostakovich, have had to write in the Soviet Union, in order to satisfy the ideological requirements of Soviet music. You may recall that both Prokofiev and Shostakovich have been in the cultural "doghouse" for their flirtation with "decadent Western modernism" and "bourgeoise" musical idioms. Which is not to say that some of these works are not interesting in their own right. The Prokofiev 20th Anniversary Cantata is a massive work calling for two choruses and four orchestras—symphony, brass, percussion and accordian. . .some 500 performers in all, which is why it rarely is played, even in Russia. The work is divided into nine programmatic sections, with orchestral and choral sections given approximately equal weight. The writing is typically Prokofiev and it is easy to discern fragments of his *Romeo and Juliet* and *Lt. Kije* and other of his music throughout the score. There are his familiar juxtapositions of great brass chorales and fanfares with sparse woodwinds, along with lovely string passages laden with pathos. The *Revolution* section, is as you might expect, a frenetic, tumultuous convocation of orchestra and chorus and is a veritable *tour de force* in the use of orchestral color. It is inevitable that some of the writing is a bit coarse and the sentiments verge on the maudlin. In spite of this, the overall effect is attractive. There is good dramatic cohesion, and the dynamics of the work are undeniably exciting. Recording a work like this is a formidable task. The sheer size of the forces involved conspire against a good balance and sufficient definition to ensure good articulation. Choice of hall is of course a major consideration. The one is this recording seems to be a shade too reverberent, and with the disposition of the various forces and the mike placement, the sound is frequently "murky" and amorphous. All considered, however, it is possible to get a good sonic picture of this huge score. The percussion is better than one would expect, with very solid bass drum and good tympani sound. The brass, too, often sounds out with great sonority, especially trombones and tubas. This kind of music calls for room-filling playback levels, and unfortunately at those levels tape hiss is obtrusive. I still prefer "Alexander Nevsky," but this is an engaging work with many thrilling moments.

The Shostakovich piece is decidedly less notable, much lighter in aspect and really quite ingenuous. It reminds one of the more obvious displays of Soviet propaganda that we used to see in the newsreels. Sort of background music for the scene in Dynamo Stadium in Moscow where we see thousands of dewy-eyed maidens dressed in diaphanous white gowns, each clutching an olive branch and singing praises to Mother Russia. . . Soviet style. Ah well, it has it's moments. . .it is difficult for someone of Shostakovich's genius to write anything *really bad,* devoid of any saving graces! Sound values in this piece about on a par with the Prokofiev, with somewhat better articulation, mainly due to the smaller musical scale of the work.

Guitar and Percussion, Siegfried Behrend, guitar; Siegfried Fink, perc., Ampex/DGG, L3034, open reel, 7½ ips, $7.95.

Here is a tape you might pass over, after reading the rather dry-sounding description of the music. If you did, and you are an enthusiast of unusual instrumental timbres, you would be missing something rather special. This is a collection of medieval and modern works for guitar and percussion that ranges from simple dances for guitar plus small tympani to some quite "far-out" works for guitar and an extremely complex assemblage of percussion instruments. There is every kind of bell, gong, cymbal, chime, and other high percussives you can imagine, along with all kinds of drums, except bass drum. All are played with obvious mastery by the two virtuoso performers. The sound is pristine clean and the transients razor sharp. Frequency response is very wide, with an exceptional top end that will delight the owners of the more exotic tweeters. Much of the scoring is very open and there are many rests, and while the level of tape hiss was fairly low, this sort of thing just cries out for the Dolby treatment.

Bizet Spectacular, Camarata conducting the Kingsway Symphony Orchestra, Ampex/London L75047, open reel, 7½ ips, $7.95.

Spectacular is indeed the word for this production, one of the best "Phase Four" recordings London has issued. The first side is devoted to highlights from "Carmen," replete with an introduction that features the traditional trumpet fanfare and crowd noises of a bull fight . . . a bit of innocuous corn. The Camarata arrangements of the main thematic material from the opera will very likely give musical purists apoplexy, but recognizing the intent of this production, they aren't at all unpalatable, and the music is beautifully performed. The sound is of exceptionally high quality. Engineer Arthur Lilley has achieved just the right balance of crisp orchestral definition with a moderately spacious acoustic perspective. Internal balances are good too, with little of the annoying "spot-lighting" of instruments out of musical context that mars many of the "Phase Four" recordings. The sound is exemplary for its wide frequency response, lack of distortion, and sharp clean transients. Add the pluses of a really low level of tape hiss and the almost total absence of print-through or crosstalk. The second side features excerpts from the "L'Arlesienne Suites 1 & 2," "Jeux D'Enfants," "The Fair Maids of Perth," and "The Pearl Fishers." Here Camarata is much more straightforward in his arrangements and once again elicits really superior playing from the orchestra. Lovely music . . . great sound . . . you can't go wrong with this tape!

Schubert: Symphony # 9 in C Major, Herbert von Karajan cond. the Berlin Philharmonic, Ampex/DGG, L9043, open reel, 7½ ips, $7.95.

The always controversial von Karajan plays things fairly close to the vest in this recording and thus turns in a performance which many critics have labeled "definitive." This is a word which is bandied about rather too easily in critical circles, but one is forced to admit that this taut, dramatic reading is indeed quite extraordinary. If one takes into consideration the factors of orchestral polish and execution and the exceptionally good sound, this must rank as one of the recordings most likely to be found in the libraries of the most discriminating music lovers. Deutsche Grammophon's famed recording engineer, Gunter Hermanns, has given us a massively proportioned sound of great sonority. He generally favors a fairly broad acoustic perspective. This we have . . . but not at the expense of orchestral detail. The inner orchestral balances are so well handled that clarity is outstanding and rarely does any instrument, or group of instruments cover or "swamp" each other. Directional effects are positive, but not exaggerated. Every element is very clean, the overall sound wide in frequency response and dynamic range. Played back at a room-filling level, tape hiss was quite moderate, and there was but an infrequent smidgen of print-through. It was a pleasure to listen to this superb recording and it is highly recommended to you.

WHEN THE DOOMSAYERS have done their thing, and the politicians have used up their sham panaceas, the remedy for many of man's ills can be found within each of us—the ability to laugh, particularly at ourselves.

Try it. Giggle a bit. Chuckle or chortle or laugh aloud. Suddenly those dark shadows don't seem so gloomy, those problems don't seem so heavy. And if you need some artificial stimulants, you might listen to a few comedy records.

The best available at the moment, probably because it sticks to a single precept and isn't trying to tear down the *entire* Establishment in one half-hour outing, is Lily Tomlin's **THIS IS A RECORDING** (Polydor, 24-4055). The comedienne, a regular on video's "Laugh-In," puts the screws to a favorite target of everyone who ever had a buzzing in the ears, the monopolistic telephone company.

In character as "Ernestine," a nasal, coarse, haughty operator, Miss Tomlin manages to take to extremes situations we all seem to have faced at one time or another. "Go look it up yourself, I've got better things to do," she tells one hapless victim of Alexander Graham Bell's gadget.

Ever been late paying your phone bill? Just hope Ernestine doesn't act as collection agent. She threatens one caller, on the record, with the loss of both service and "the use of one eye." Another she blackmails—oops, her term is "a vicious threat"—by playing a recording of a previous phone conversation. "Recognize the other voice?" she asks with poisoned sugar in her tone.

Although the 17 cuts are uneven, as should be expected from any comedy album, there are enough funny bits and one-liners to evoke laughter from the most stone-faced member of the audience. In fact, the merriment of the crowd at the Ice House in Pasadena, Calif., where the disc was recorded, is quite noticeable—not enough, thankfully, to mar the armchair audiophile's enjoyment of the performance.

Miss Tomlin, who starts with a spoof-biography of the phone's inventor, makes calls to Joan Crawford, J. Edgar Hoover, and Martha Mitchell—plus an assortment of just-plain joes (including Vito, a repairman and self-styled Don Juan). None of the satire will cause hysteria, but all of it is rib-tickling . . . especially for those who like sexual undertones and double entendre.

Born in Kentucky but reared in Detroit, Miss Tomlin, who is rushing headlong toward 30, feels that Ernestine satisfies a need of the public to lash out at a giant corporation which is normally out of reach. To keep that need satisfied, she reportedly turned down a half million dollar contract to do commercials for Bell. Does that make her a comedienne with integrity—or, appropriate to the character she plays, a ding-a-ling?

* * *

Another bright voice from the wasteland that is television is a young man who seems to pop up on the "Tonight" show with more frequency than host Johnny Carson. **DAVID STEINBERG . . . DISGUISED AS A NORMAL PERSON** (Elektra EKS-74065) is his debut LP, just as Miss Tomlin's is hers, and it is a finely honed thing that will appeal to all who believe, as Steinberg does, that female contestants on "The Dating Game" have an IQ "around that of the average plant."

His humor is fresh, clever and vital. Also, it is sometimes far out. "I have this innate fear," he reveals, "that one evening late at night all the Volkswagens are going to drive all the Jews back to Germany." Unless you're a Nazi, you've got to laugh.

Steinberg's humor, too, is heavily spiced with sex references, but his main thrust is satire. On the vinyl, recorded live at the Bitter End in New York City, extracts from some of the Biblical bits he has done on the idiot box, including one that caused a censorship fight on the demised Smothers Brothers show.

The comedian himself also is a target of his forked tongue on many of the 13 tracks. "My parents were intelligent, enlightened people," he notes. "They accepted me for exactly what I was—a punishment from God."

* * *

Bill Cosby, on his latest Uni album, **WHEN I WAS A KID** (73100), does what he does best—tells witty anecdotes based on his childhood in Philadelphia.

The album, recorded live at the Westbury (Long Island) Music Fair, is a half-hour of joy punctuated with applause and laughter and featuring Cosby's youthful buddies, Fat Albert, Dumb Donald, and brother Russell.

One of the highlights is the first of eight tracks, "Hernia," on which the comic relates that "my mother . . . says you keep picking people up, you gonna get a hernia. I thought it was a present." Another gem, "My Boy Scout Troop," dipicts a camping trip in the traffic-jammed heart of Philly.

Cosby's humor, uniquely, is for almost everybody. If you can remember your childhood at all, hearing this will put a warm glow around it. As he says on the liner noted, "This is dedicated to all of the kids who *were* kids and are now big kids that remember the fun they had when they were little kids because little kids have more fun than big kids because they forget pain a lot quicker than big kids."

* * *

The biggest arena in comedy records these days, however, is the political scene—with everybody taking pot shots at everybody. Among the better offerings are a pair by a black comic-politician, **DICK GREGORY LIVE AT THE VILLAGE GATE** (Poppy, PYS 40,011) and a two-disc package, **DICK GREGORY'S FRANKENSTEIN** (Poppy, PYS 60,004); **SPIRO T. AGNEW IS A RIOT** (Cadet Concept, CCX-1), starring Stanley Myron Handleman as the vice president; **RADIO FREE NIXON** (Elektra, EKS 74085), with David Frye impersonating the guy we wish we didn't have to kick around anymore; **SUPERSHRINK** (Janus, JXS 7001), with Alen Robin using electronic gimmickry, and half of **WOODSHTICK AND MORE** (Capitol, ST-681), a disc that features a segment of "Earwitness News."

Gregory, who mixes vitriol with humor, sprinkles topical references (many, unfortunately, somewhat outdated) into his monologue. Utilizing a scattergun technique that attacks everything in sight, he is most venomous with the vice-president. "You're all having fun, drinking it up like there was no Agnew," he admonishes a glass-tinkling audience. And if that were not bad enough, he notes that "Agnew reminds me of the type of cat who would make a crank call to Kosygin on the hot line."

Excessively using the phrase "dig it," the comic talks too fast at times, making it difficult to understand him, and at others is too close to the microphone. Still, if you can tolerate his insolence (many would spell that t-r-u-t-h), you will appreciate his spiel and its undercoating of sermon. For instance, he sardonically tells Catholics in Ireland not to press so hard for freedom. "Be patient," he intones, indicating they should be more like blacks in the U.S. "Harlem wasn't built in a day."

The other Gregory package, recorded at the Bronx Community College in New York City, deals with racial tensions, riots, superpatriots, the Chicago trial, dope, poverty, communism, capitalism, civil rights and a host of other news-oriented subjects.

But Gregory, naturally, emphasizes the plight of the Black Man—usually with the rattle of the funnybone, always with seriousness. Witness his comment about the urban situation: "You white folks gave us the cities . . . and the capital of the United States, that's all us."

David Frye, in contrast, has few moments of viciousness but many that showcase lighthearted puncturing of our leaders. The mimic, who on the album produces likenesses of Nixon, Henry Fonda, George C. Scott, Al Capp, LBJ, Billy Graham, David Susskind, William Buckley, Agnew, Truman Capote, Howard Cosell, Nelson Rockefeller, Hubert Humphery and William Fulbright, is clever at times, heavy-handed at others. Like the girl in the famed lyric, when he's good, he's very, very good, but when he's bad, he's horrid.

The 16 mini-cuts—which include a 3:12 quasi-musical version of "My Way" as rendered in the voice of the President—do not come up to Frye's first vinyl—but, then, few sequels equal the original.

Filled with satirical material (from the pens of five writers), all tied together via the theme of a radio station, WNIX, run by the man in the White House, the recording nonetheless is worth hearing—once. Especially if you're anti-administration.

The Handleman recording is a distinct opposite to the Frye performance, for Handleman makes no attempt to disguise his Jewishness or ape the vice president's style. There is humor in that alone, but there is more in the situations re-created. Spiro, for example, is chided on his use of large words, his inadvertent attacks on ethnic minorities, his disjointed verbal patterns, his alliterative phrases, his PTA background, his tennis (and golf and baseball and hunting) accidents—and his allegedly divisive and repressive tactics.

Most amusing is a verbal battle between the vice president and Buckley (which the latter wins), narrated in word-by-word blows by Earl Doud, the album's producer. Also breezy is the spoof of Agnew's appearances on the David Frost video opus, with Harold Oblong portraying interviewer "Jack Frost."

The one-liners, of course, are always incisive: "I would never want to insult a person of an inferior race," says Handleman as our V.P.

But once again, there's a touch of sadness underneath. How much truth is in the liner notes, for instance, when it is written: "We, the producers and writers of this album who incidentally are not of draft age, would like to point out that we are certainly fortunate to live in a country which accepts free expression in the knowledge that even though we might poke fun at someone in high office, he respects the freedom we in this country enjoy, and accepts what we have done with a hearty laugh. Only in America could this happen, and in all probability it'll be that way for at least a couple of months."

Another contrast, the LP lampoon of psychiatry and politics simultaneously, utilizes the actual voices of Nixon, Agnew, Rockefeller, Humphrey, Mayor Richard Daley, Sen. Strom Thurmond, Gov. Ronald Reagan, LBJ, Buckley, and Mayor John Lindsay.

Alen Robin's "sessions in therapy" are a masterful editing job. They contain, for instance, a redundancy of phrases that elsewhere would be annoying, but here are utilized to stimulate more laughs. Although many of the situations created are ludicrous, outlandishly inconsistent with the personalities depicted, the premise is a clever one.

Robin, who was head writer of the "Tonight" show for a time, wrote an earlier comedy disc, "Welcome to the LBJ Ranch" a few years back. This is better.

Finally, the Woodstock spoof, on its flip side, goes into an elongated bit based on a dream by Nixon (but is tied excessively to last year's election and its emphasis on the law-and-order theme.) The satire includes the Mitchells and (who else?) Spiro. By this time, we're ready to say ho-hum. But there *are* a few funny lines.

The segment also nails the war, pot, the press, anti-pollution mouthings of big business, the Kent State debacle—and commercials for products which have no beneficial effects.

The first side of the LP, which also features the writing and performing talents of The Credibility Gap (a trio consisting of Richard Beebe, David L. Lander and Harry Shearer), turns the idea of Woodstock around by setting the scene in a hotel room jammed with comedians. Satire, it seems, is also the trio's business—for the three started as radio news analysts, later deciding that political and sociological humor made more sense (and cents).

Laugh and the world laughs with you? Well, maybe not, but would you believe that it's difficult to shoot someone when you're doubled over with laughter.

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13			28			43			58			73			88			103			118			133		
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