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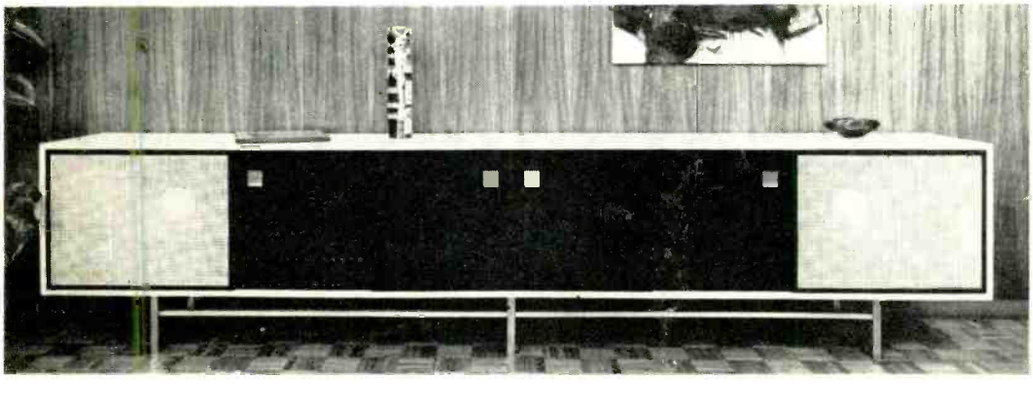
AN ENGINEER LOOKS AT EXPONENTIAL HORNS-PAGE 30

BONUS: AUDIO AND HI-FI IN WEST GERMANY ... PAGE 47

EL CHEAPO 2-30

TRANSISTOR POWER AMPLIFIER *YOU* CAN BUILD

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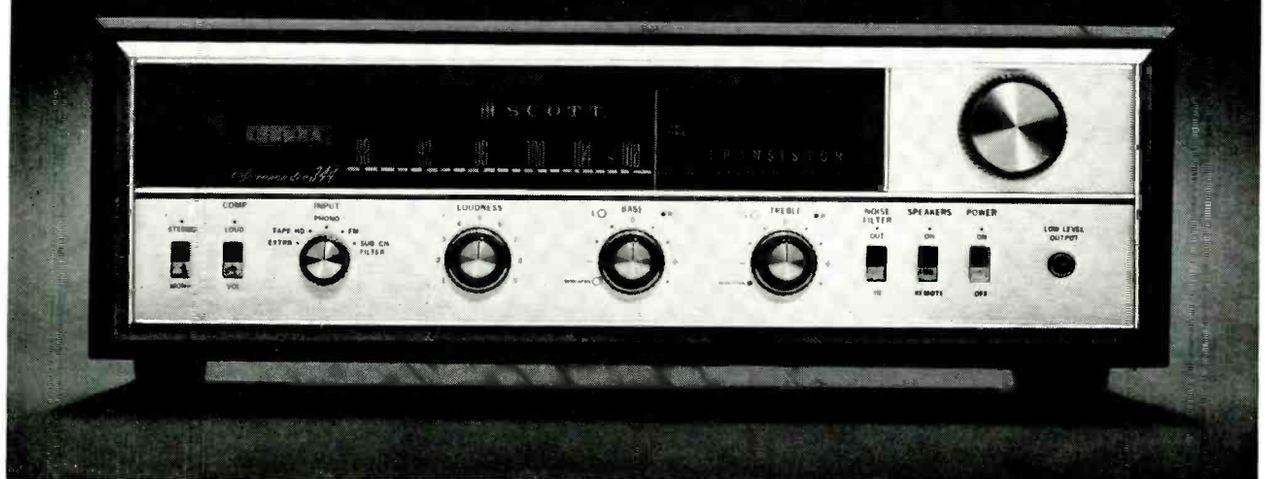
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Announcing another Scott engineering breakthrough . . . the sensational-sounding new Scott 344 solid-state tuner/amplifier

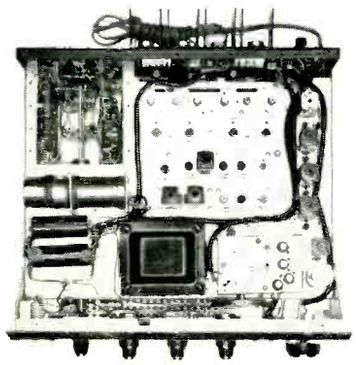


"It's great!", "The sound was fabulous", "I never heard anything like it!" . . . These were the comments of Scott's product evaluation panel, the most critical, exacting, demanding group of audio perfectionists in the industry. The subject of this hard-won praise was the new Scott 344 solid-state tuner/amplifier. Now, Scott confidently invites your own personal evaluation of the 344. See it . . . hear it . . . compare it and decide for yourself if you have ever before experienced sound so clear, so sparkling, so lifelike . . . or if you have ever seen a more handsome unit.

The tuner section is the same as that of Scott's pioneering solid-state 312 FM stereo tuner, of which Audio Magazine (July 1964) said: "It is one of the finest tuners Scott makes. And that means it is one of the finest tuners anywhere." The 344 features Scott silver-plated front end for maximum sensitivity, all-silicon IF stages for sharpest selectivity, four stages of flat line limiting for the most noise-free FM listening, and Scott-developed Time-Switching series gate multiplex section for the most distinct stereo separation.

The revolutionary amplifier section of this new 344 uses entirely new Scott-developed circuits. These circuits represent significant engineering advances in the state of the art. . . . Peak power capabilities approach one hundred watts, enough to handle the extreme dynamics of any music.

Scott engineers have imaginatively applied space-age miniaturization to achieve a most compact precision instrument. The 344 is as small as an ordinary tuner . . . so it can fit where larger units cannot. Visit your Scott dealer soon . . . but be prepared for a new experience in listening.



Tuner Section . . . Silver-plated, four-nuvistor front end assures high sensitivity with no cross modulation problems. (Audio Magazine reported 2.0 uv IHF sensitivity with 82 db cross modulation rejection!) Flat line limiting makes the 344 virtually impervious to ignition pulse noises and overloading caused by strong local stations. Solid state circuitry assures long trouble-free operation without need for realignment.

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AUDIO

Nov., 1964 Vol. 48, No. 11

Successor to RADIO Est. 1917

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AUDIO Articles

The El Cheapo 2-30	19	*R. R. Moore*
The RCA Victor "Dynagroove" System—In Two Parts—Part One	22	*Harry F. Olson*
An Electronic Organ Design—In Two Parts—Part Two	24	*Winthrop S. Pike*
An Engineer Looks at Exponential Horns	30	*W. A. Dodge*
A Basic Course in Commercial Sound—Chapter 8	43	*Norman Crowhurst*

AUDIO Reviews

Light Listening	8	*Chester Santon*
Record Revue	40	*Edward Tatnall Canby*
Jazz and All That	65	*Bertram Stanleigh*

AUDIO Profiles

Goodmans Loudspeaker System	66	*Maximus I*
Magnecord Stereo Tape Recorder	66	*Model 1024HF*
ADC Loudspeaker	68	*Brentwood 303A*

AUDIO in General

Audioclinic	2	*Joseph Giovanelli*
Letters	6	
Audio ETC	10	*Edward Tatnall Canby*
Editor's Review	16	
New Products	36	
Audio and Hi-Fi in West Germany	47	*C. G. McProud*
Cover Story	68	
New Literature	69	
Tape Guide	70	*Herman Burstein*
Industry Notes	93	
Advertising Index	94	

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Number 15 in a series of discussions by Electro-Voice engineers



DEATH OF THE TINHORNS

JACK BURCHFIELD
Chief Engineer
Loudspeakers

Over the past few years, public address loudspeakers have been introduced using new materials to replace the traditional aluminum and steel horns common on such equipment.

The first departure from tradition began with the Electro-Voice 818 (or "CDP®" for Compound Diffraction Projector). It was the first speaker to utilize Fiberglas-reinforced polyester resin construction. The initial use of this material, resulted from the solution to a unique and challenging loudspeaker problem.

The U.S. Navy faced a difficult sound distribution problem on the decks of Forrestal-class aircraft carriers due to the adoption of extremely noisy jet aircraft. To meet this specialized need, high-powered, wide angle speakers with great strength and low silhouette were required for installation at the edges of the flight deck. Fiberglas diffraction horns proved to be ideal. It was not long before commercial units, similar in concept to the Navy models, were introduced as the Models 848 and 847.

The Fiberglas horns have several advantages of interest to commercial sound installers, in addition to high impact strength. They do not rust, dent, corrode, or peel. Color is molded in, and regular painting is not needed. The shape of the horn can be molded to suit various sound distribution needs. This E-V innovation made rectangular wide angle designs practical.

Recently E-V continued its pioneering in plastics with the introduction of two new paging speakers. The smaller of the two, the PA7, is molded of Cycolac, while the PA30 utilizes Implex R material for its construction.

These unusually rugged horns offer distinct appearance advantages to the sound contractor. No maintenance is required, since neither of these materials is affected by high humidity, reasonable levels of heat or cold, or corrosive atmospheres. The color is molded completely through the horn, and a smooth attractive finish is automatically produced.

Of course, modern plastics contribute to more than just appearance. The resonance characteristics of Cycolac and Implex R can be controlled for results superior to typical metal paging horns. High uniformity of product, plus unique horn shapes dictated by acoustical requirements can be achieved by careful tooling.

While Electro-Voice continues to produce products using traditional materials, these plastic horns represent the benefits of E-V research into modern materials and methods. Application of new ideas to solve your sound problems is the goal of Electro-Voice engineering.

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• A Basic Course in Commercial Sound. Norman Crowhurst. Chapter 9. Stereo Installations.

Recording

• Recording the "Muse." Arthur C. Matthews. Recording drama in stereo.

Profiles

• Weathers "Townsend" Turntable
• Bogen RT6000 Solid-State Stereo Receiver
• AR-4 Speaker System

In the December Issue

On the newsstands, at your favorite audio dealer's, or in your own mailbox.

AUDIO CLINIC

Joseph Giovanelli



Send questions to:
Joseph Giovanelli
2819 Newkirk Ave.
Brooklyn 26, N. Y.
Include stamped, self-addressed envelope.

(Some of the questions in the next few columns are presented because of the difficulty in answering them fully. Maybe some reader has experience which can help in these areas. If you have any suggestions related to these questions, please write me. I'll try to run them either in this column or in my other, sporadic column, "Audio Techniques." If you have any suggestions which you believe might improve this column in general, I will read them with interest and with appreciation.)

Tuner Limiting

Q. In my particular location, auto ignition interference on both monophonic and multiplex reception is quite severe. As a result, I have not found a solution regardless of the therapy applied. I have installed an outdoor, 12-element high gain Yagi antenna with rotator, placed in the least offending location and height. The recommended coaxial shielded lead-in, complete with baluns at antenna and tuner is used. My tuner and MX adapter are completely shielded. Both the audio system and the antenna array are correctly grounded. All connections are good.

In my location, San Francisco FM stations are no more than 25 to 30 miles away. Because I am located on top of a hill, only higher hills between my antenna and the broadcasting antenna site screen "line of sight reception." In addition, the highway which is the apparent source of the problem runs below my location, but between receiving antenna and the direction of the FM signal. The tuning meter on the tuner indicates an extremely strong signal, but there is no denying the fact that the ignition interference is almost as strong and apparently is entering through the antenna.

Unfortunately, the noise caused by ignition systems is prevalent throughout this location. It is evident on TV picture and sound.

We have attempted a stacked array and even stacked array spacing, intended to phase out the interference with very little success. Grounding the baluns does not help.

What do you suggest I do to eliminate the culprit in view of my location? (I've considered moving, giving up the desire to record, and dropping out as a member of the consuming industry.) Would a wavetrap device reduce the interference? J. Holland, Orinda, California.

A. Only two possible remedies suggest themselves for your problem. I do not guarantee that either of them will effect a cure.

First, the use of a booster *may* bring about some improvement. It is true that a booster will amplify noise as well as signal but the increased signal thus produced may increase limiter saturation, thereby reducing the ignition noise.

Second, a tuner with better limiting than your present one may bring about a cure. There are dealers who will cooperate with a customer until he has found the piece of equipment which meets his needs.

Readers, what do you think?

One thing *is* sure, the wave trap will not help you. The ignition noise occupies the same frequency band as the FM signals you wish to hear. The trap will attenuate both interference and desired signal.

An Unusual Noise Problem

Q. I own a separate amplifier and preamplifier. When the system is turned off, I get a low-frequency pulse or series of transients through my speaker. The nature and magnitude of the transients varies and may sometimes be absent altogether. The transients never occur when the audio cable is disconnected from the amplifier.

To date, I have replaced both tubes in the preamplifier twice, replaced a 0.01 final coupling capacitor, placed a 0.02 (1000v) capacitor across the a.c. switch on the valume control, resoldered all *connections, and substituted different audio cables to the power amplifier. Reorientation of the plugs of the associated equipment was also tried. The transients still occur. Their occurrence is independent*

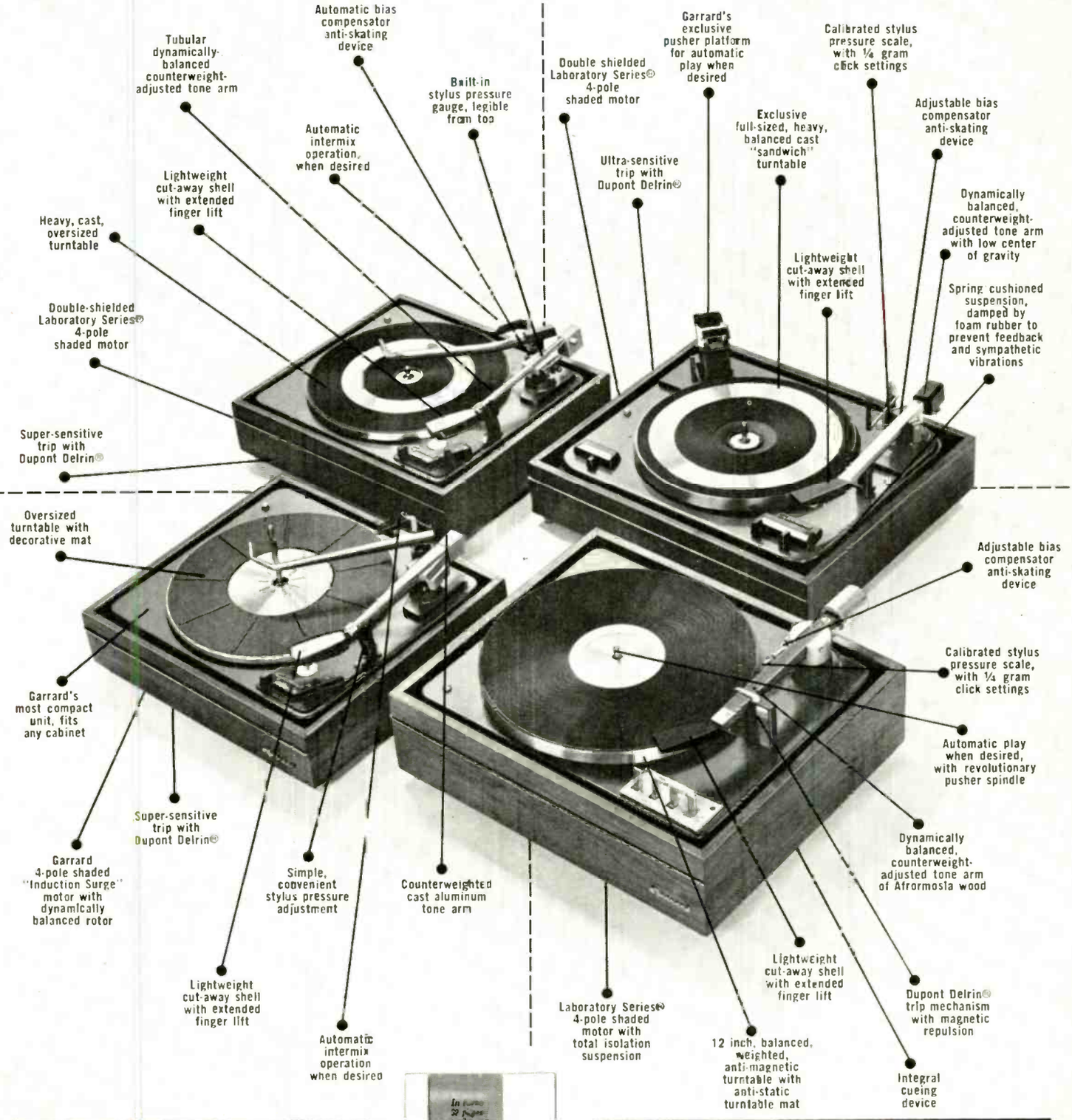
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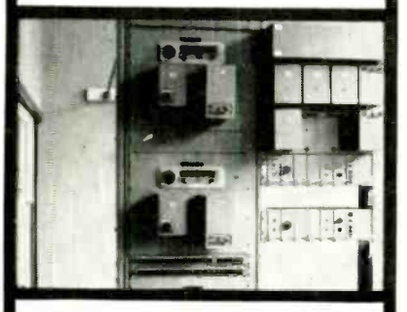
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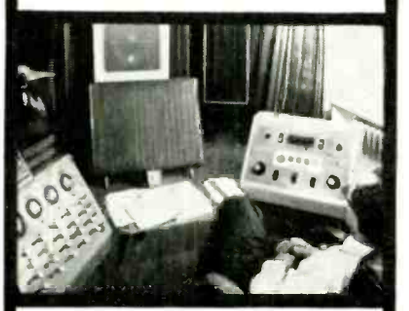
A studio control room where the programmes are passed through a QUAD control unit for special balancing.



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of what input the selector switch is set on, and whether or not anything is connected to the inputs. Robert Rothchild, New York, New York.

A. Your transient problem is a tricky one. You have already done most of what I would have suggested. However, I recently had a similar problem. I found the answer to be out of the ordinary. It is possible that your problem has the same answer.

It often happens that wear or oxidation makes the lower end of a control erratic in operation. This fact can escape notice because we seldom need to set controls to their minimum position. When the equipment is turned off, however, the control is rotated to that extreme minimum position in order to activate the switch. It just might be that your control is intermittent at the point where the switch contacts open. If this is the case, try cleaning the control with contact cleaner or replacing the control with a new one.

Unloaded Power Amplifiers

Q. My problem concerns operating a high fidelity amplifier with no load on its outputs. I believe that this can be safely done with solid-state amplifiers, but is it safe with tube amplifiers? I have heard that operation of this kind will damage a vacuum tube amplifier. I have also heard that it will cause no damage. How about it? Wendell S. Rice, Richards-Gebaur, AFB, Missouri.

A. Solid-state amplifiers can be run with "no load." However, a solid state amplifier is subject to damage if a short circuit is presented as a load.

Running some tube amplifiers without a load connected to the secondary of the output transformer will prove dangerous to component safety. What happens is that the voltage across the transformer is very high when "no load" is presented to attenuate them. These voltages may be sufficiently high to break down the insulation between the turns of the primary winding, or between the winding and the core, or may cause arcing in the output tubes. Some tubes and transformers are better than others in their ability to withstand these voltage peaks. Some amplifiers, rather than depending upon the ability of their tubes and transformers to withstand these high voltages, are designed to have a resistor whose value is somewhat higher than the impedance of the speaker which will be driven by the amplifier, placed across the secondary of the transformer. This resistor is high enough in value so that it will not take excessive power from the amplifier in normal operation, but it is still low enough in value to hold down the no-load voltage to a safe level.

Unless the manufacturer specifically

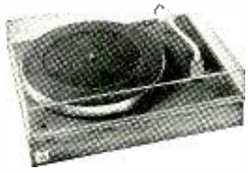
(*Continued on page 92*)

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HiFi/Stereo Review has published test reports on 9 turntables.†

The AR had the lowest rumble, wow, and flutter.

†as of July, 1964



TURNTABLE		RUMBLE*	WOW	FLUTTER
AR	(Mar. '63)	—38 db	.05%	.02%
2	(Nov. '62)	—36 db	.05%	.11%
3	(May '64)	—32 db	.07% (33⅓)	.03% (33⅓)
4	(Dec. '62)	—30 db	.15%	.1%
Changers				
5	(Dec. '61)	—35 db	.2%	.1%
6	(Sep. '62)	—34 db	.1%	.1%
7	(Jan. '64)	—32.5 db	.1%	.035%
8	(Oct. '62)	—23 db	.13%	.13%
9	(July '63)	—16.8 db	.08%	.04%

*Combined vertical and lateral rumble below the NAB reference of 1.4 cm/sec at 100 cps. When the measurements were given in different form they were converted so that they could be compared directly. The NAB standard for broadcast turntables is —35db.

The HF/SR report on the AR turntable included this comment:

> *. . . records played on the AR turntable had an unusually clean, clear quality. The complete freedom from acoustic feedback (which can muddy the sound long before audible oscillations occur) was responsible for this."*

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LETTERS

Another Live-versus-Recorded Concert

SIR:

If this addendum reaches you too late to add to my article on live-*versus*-recorded techniques, I would appreciate your publishing it in your "letters" column.

I have come across a reference to a live-*versus*-recorded demonstration that clearly should have been included in the section on historical background in my article ("Techniques of Live-*versus*-Recorded Comparisons," Oct. 1964). In 1947, at Tanglewood, RCA staged a concert with the Boston Symphony Orchestra under Koussevitsky, in which the last four minutes of Beethoven's Egmont Overture were switched over to monophonic reproduction from a disc. Twelve LC1A speakers were used. Koussevitsky called the reproduction "unprecedented."

The recording was made in the Tanglewood Music Shed, which had not yet been redesigned by Beranek and was very open. The location, combined with multi-microphone, very close-to recording, apparently made it possible to avoid the effects of double reverberation.

Details of this demonstration are described in the third edition of Dr. Harry F. Olson's "Acoustical Engineering," D. Van Nostrand Co., Inc., 1957, pp. 606 to 611.

ED VILLCHUR
Acoustic Research, Inc.
24 Thorndike Street
Cambridge, Mass. 02141

Directional Microphones

SIR:

Mr. Crowhurst's "Basic Course in Commercial Sound" has reduced the subjects to about as fundamental basis as possible. What is now proposed is not an addition but perhaps a tangential idea.

It is often assumed that a directional microphone assists in reducing feedback. One simply points the cardioid null at the loudspeaker and turns up the gain, but the system still sings. What happens is that in a normal indoor environment, wall reflections can contribute a great deal to the sound intensity. For example, in one excellent listening room the sound level was 10 decibels higher at 16 feet from the loudspeaker than it would have been outdoors for the same input to the same loudspeaker. What this means is that the wall reflections were contributing at least 9/10 of the total sound level. Pointing the cardioid null at the loudspeaker would offer a benefit of something like a fraction of one decibel.

The super-directional microphone is a different device; it has a narrow acceptance angle instead of the narrow rejection angle of the cardioid.

This letter does not aim to be a treatise on microphones, but merely to point to the fallacy of expecting appreciable benefits relative to feedback from the cardioid pattern. Our experience has been that the more nearly flat response of a good omnidirectional condenser microphone affords a higher available systems gain without feedback than any of the cardioids we have tried.

PAUL W. KLIPSCH
Klipsch and Associates
P. O. Box 96
Hope, Arkansas

Crowhurst Replies:

SIR:

Mr. Klipsch' comments may stress a little more than I did, the utility of super-directional microphones. In my experience, there is danger in emphasizing anything as a panacea. These super-directional microphones are very useful in extreme circumstances, as my presentation implied, by reference to that specific case where noise was the main problem.

Mr. Klipsch' suggestion is to use them where acoustic feedback is the main problem. From my experience with this kind of usage, there is a disadvantage to a highly directional instrument: the speaker or performer needs to be fastened in position with some kind of straight jacket, to avoid the inevitable variation in both quality and intensity that occurs if he or she changes position relative to the very sharp directional pattern.

I agree with Mr. Klipsch' comments relative to the cardioid: its usefulness is often exaggerated; for one thing, its null is insufficiently specific to be "pointed," as well as there being a standing wave pattern that makes it impossible to point it in the implied manner, if it was that sharp. In my experience, the bidirectional microphone will usually do the best job in difficult acoustic circumstances; each pickup lobe is narrower than the carbioid and there is a dead "ring," as opposed to the single dead spot of the cardioid. It gives by far the best discrimination in favor of wanted pickup and against random or standing wave pickup, of the major directional (including omni-) types. It also has a much smoother response from various directions than do most cardioids of comparable cost.

There is such a wide variation in all of the types, that generalization is dangerous. There are smooth cardioids—

(Continued on page 82)

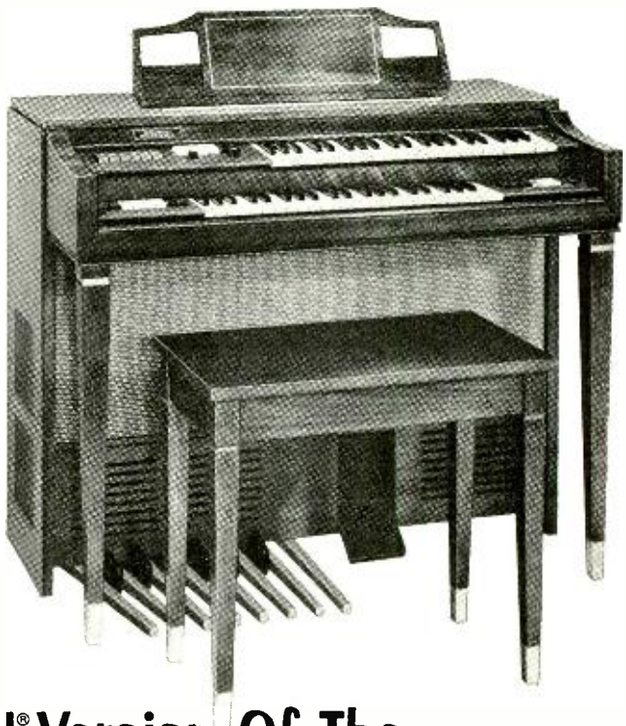
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LIGHT LISTENING

Chester Santon

The Singing Nun
Philips Stereo Tape PTC 603

A critic's curiosity can lead the way to quite a tangle of questions when considering monophonic recordings that have been electronically reprocessed for "stereo." Legerdemain in mono discs has been going on for several years in an effort to give them some of the attributes of stereo sound but this Philips reel is the first tape I've come across containing material converted from mono to "stereo." When Philips recorded the Singing Nun (Soeur Sourire) in the song "Dominique" they little suspected that an obscure mono recording would come into sensational demand in areas where stereo was already an everyday word. Their response to this demand for two-channel sound was the release of disc #PCC 603, a reprocessed version of mono Philips PCC 203. Now that the label has joined the family of Ampex Stereo Tapes (formerly United Stereo Tapes), it is possible to compare all three versions of the famous "Dominique" album—reprocessed stereo on tape and disc as well as the original mono disc. The moment I began to fool around with the two discs, trying various selections at the same volume and identical playback curves, the questions began to point in one direction. Audition of the tape solidified the questions into one lump. I'm sure most listeners, upon checking all three items, would join me in putting this final question to Philips Records: "Why on earth go through the bother of converting this mono release to stereo?" By far the best results I was able to get came forth in playback of the mono disc through both channels of my regular stereo setup. In mono, the voice of Soeur Sourire, nicely blended with her guitar, appeared to come from a point a few inches forward of an invisible line stretching between my two speakers. Presence of soloist and accompanying singers was excellent. The disheartening thing about the reprocessed material was the fact that the tape shared all the problems of the "stereo" disc. I've never heard anyone attempt to blame the stereo cutter for the type of sound we've been getting on "stereo" discs taken from mono material. Were I to hear such an accusation after checking all three recordings of "Dominique." I'd certainly hasten to absolve it on the basis of practical experience. The voices of the charming nuns are just as disappointingly metallic and hollow on "stereo" tape as they were on "stereo" disc. In both reprocessed versions the artists are way off mike, appearing to come from a point about four feet beyond my speakers. Whatever Philips did in trying to get a two-channel effect with their original mono recording they have only succeeded in pushing the voices out of focus with nothing gained anywhere in the process to balance the loss.

Oklahoma
Columbia Stereo Tape OQ 653

The tape catalog is finally playing host to an "Oklahoma" reel with several Broadway luminaries in its cast. For many years the main "Oklahoma" choice available to the tape fan has been the Capitol soundtrack of the movie that starred Gordon MacRae. The Capitol reel offers sound quality that is completely acceptable by today's tape standards. As a matter of fact, I prefer its studio acoustics to those of the new Columbia reel but the stars of the latest release bring more theatre experience to the great Rodgers and Hammerstein score. John Raitt and Florence Henderson, the leading players in the Columbia album, have toured the country in road companies of "Oklahoma." They fit the characters of Curly and Laurey just about as well as the members of the 1943 original cast recorded by Decca. My only objection to the new Columbia recording is the cramped acoustical setting. "Oklahoma," of all shows, calls out for air space around the cast for true stereo recreation of the southwestern locale. Unfortunately, as with other Columbia "360 Sound" show albums, stereo depth and room ambience are kept to a minimum. For this release, and the new recording of "The King and I" with Barbara Cook and Theodore Bikel (OS-2640), Columbia has commissioned new orchestrations by Philip J. Lang. I prefer the stage originals.

Leroy Holmes: Fifty Fabulous Years
United Artists UAS 6373

Everything seems to be coming up fifties in the latest series of releases from United Artists. In this stereo disc by the Leroy Holmes Orchestra as well as an album by the Washington Post Marching Band and six companion releases, the UA label is aiming its sights at the listener who feels vaguely discomfited when buying an album with only twelve or fifteen selections. Since this Holmes recording manages to cover fifty years of American popular music in its fifty selections, it should be the top seller of the new series. With only a minute or so of playing time available for each tune, beginning with *Charleston* and ending with *Blowin' in the Wind,* this can be no more than a capsule anthology but the sound is brighter than that of earlier, more elaborate collections.

The Concert Sound of Henry Mancini
RCA Victor LSP 2897

Concert sound they call it and concert sound it is. A seventy-piece orchestra conducted by Mancini demonstrates in concept and studio miking a fancy treatment of movie music that could serve as a model of its kind. Made in the vast Goldwyn Studios, the recording is a follow up to a concert that took place in Hollywood Bowl with Henry Mancini conducting his own special arrangements. For the occasion he devised four "concert suites." Two of these are tributes to fellow composers David Rose and Victor Young; one suite concentrates on Academy Award selections and the last one is given over to Mancini specialties lumped under the title "Peter Gunn Meets Mr. Lucky." Lush treatment of Hollywood's musical output by means of large orchestras has been going on for decades but this release offers the special know-how of an insider unusually adept in the game of winning musical awards.

Robert Farnon: Captain from Castile
Philips 600-098

The Philips label, available in this country through its tieup with Mercury Records, has long been a potent factor on the European record scene. In the popular field, the outfit didn't hit the limelight here until the release of its best selling album by the Singing Nun. Moving across the channel to England, the label now presents the orchestra of Robert Farnon whose music has already become fairly well known here on the London and M-G-M labels. Philips miking pattern and full use of natural big-studio ambience follows the familiar (and welcome) tradition of recent stereo releases from overseas. I was particularly interested to note that Philips' popular recordings do not suffer from the anemia of bass response I have noticed in many of their classical discs. In addition to other movie themes, the first half of this album is devoted to Alfred Newman's score for the old film, "Captain from Castile." Many of the original Castile themes have been reworked and enlarged by Farnon. *Aztec Drums,* originally no more than a short cue in the picture, has been expanded into one of the best items in the album. The only fly in the ointment: *Conquest,* the most stirring selection in the film, has been relegated to the last band on the side where only a portion of its sonic impact has a chance to come through.

Ella Fitzgerald: The Jerome Kern Song Book
Verve V6 4060

Ella's song books of our leading composers are pretty well established as classics of their kind. An addition to this series, no matter how belated, is a notable event in the popular music field. As in the case of Gershwin, Porter, Arlen and Berlin, Miss Fitzgerald takes the trouble to seek out less-frequently-heard Kern tunes in a collection that ranges in time from 1929 to 1942. Nelson Riddle provides his usual perceptive arrangements, leading his orchestra in accompaniments that underline the gentle approach Ella brings to Kern's music. The combination is a disarming one.

Kate Smith at Carnegie Hall
RCA Victor LSP 2819

It's hard to believe that the absence of a major recording contract in recent years has been a serious problem to a singer who has earned something in the neighborhood of 35 million dollars over the past 32 years in radio, television and on records. Anyone old enough to tune a radio set in the Thirties will be astounded to hear how fresh and rich the Kate Smith voice sounds today in this stereo recording made during a Carnegie Hall appearance. Receivers of that day and 78 rpm discs could not hide the fact that Kate Smith was one of the show business greats. This RCA disc reveals in full detail the amazing vocal technique that took her to the top. With the help of an orchestra under the direction of Skitch Henderson and a chorus under Will Irwin, Miss Smith delivers a smartly-paced program that mixes ballads she made famous, a few modern items such as *Moon River* and *What Kind of Fool Am I?* and Irving Berlin's *God Bless America* which she introduced on Armistice Day in 1938. It would be asking too much to expect today's swinging generation to dig Kate Smith in her entirety. It is, however, worthy of note that this recording marks one of the very rare occasions when a great voice of the past has been captured in such a state of preservation on a modern recording.

Peter Nero: Reflections
RCA Victor LSP 2853

In the pop record field, most producers nurture a favorite formula. The more money they make through application of a rigid formula, the deeper their conviction that the formula should never be tampered with. In the latest album by RCA's current highriding piano star, we have an illustration of a favorite formula being set aside for the moment in favor of a new one. Peter Nero made his reputation during the past three years by applying a spate of ornamentation from classical music to all sorts of popular material. In his latest release, the tenth for the only label he's working for, Nero has switched to what could be considered a much older formula. Here we have a compilation of the selections most frequently requested by audiences during his many personal appearance from coast to coast. Since such requests cannot be answered on a moment's notice with the thought that goes into a typical Nero arrangement, this album is one way to take care of the requests. The lineup of tunes (*She Loves Me, My Coloring Book* and *Days of Wine and Roses*) would indicate that the old standards are not heavily in demand these days. AE

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The Fisher XP-10, $249.50



"The XP-10 is truly a step forward in smoothness, transient response and musical quality. It handled percussion, piano, strings, brass, and what have you, as cleanly and precisely as any speaker system we know." —AUDIO magazine, March, 1964

The following is AUDIO magazine's "Equipment Profile" on the Fisher XP-10 Consolette speaker system, reprinted in its entirety:

The Fisher XP-10 was introduced in the latter part of 1963 and represents the crowning achievement of the Fisher line of loudspeakers. It is a three-way system encompassing a 15-in. woofer, an 8-in. midrange speaker, and a "soft dome" hemispherical tweeter.

Before going forward with an explanation and description of this speaker system, it might be worthwhile to look back briefly. If our memory serves us correctly, Fisher has been making speaker systems for only a few years, and yet some trade sources indicate that they are amongst the top few in current popularity. A rather striking performance which has been largely unheralded. Undoubtedly part of this success was due to the fact that the Fisher name was on these speakers. Equally important, however, was the fact that the progression of systems have been excellent performers for their day and age, and have been consistently upgraded over the years. Thus we arrive at their best and most elaborate system to date.

The XP-10 is also the finest piece of speaker furniture produced by Fisher, which is only partially indicated in the illustration. Measuring 24⅜-in. wide, 30½-in. high, and 14⅜-in. deep, it makes an unusually handsome piece of furniture with its Scandinavian Walnut exterior. Now let us take a look at what lies beneath that exterior.

The Woofer

The 15-in. woofer features the eddy-current damped electrolytic-copper voice coil which was introduced in the Fisher XP-4A. This technique provides excellent damping, and thus excellent transient response. The open air resonance of this speaker is 18 cps, and in the enclosure provides good output in the 30-cps region. The crossover frequency of 200 cps permits the woofer to operate in its most effective range and avoids some of the phasing problems resulting from a higher crossover point. The low-frequency driver utilizes a 6-lb. magnet structure.

Altogether, the 15-in. cone, the powerful driver, the excellent damping, and the low crossover frequency combine to produce clean and tight bass.

The Midrange Speaker

Often, the importance of the midrange speaker is overlooked, especially since it is usually the least expensive speaker in a decent-quality three-way system. In fact the midrange does the lion's share of the work since it must carry the majority of the orchestral fundamentals. Just glance at one of those charts which show the frequency range of orchestral instruments if you want to be convinced.

In addition to doing all that work, it must also be a smooth bridge between the woofer and tweeter. We can't overstress the importance of properly bridging the high and low frequencies in a three-way system; a poor bridge can make even the best woofer and tweeter sound somewhat poor.

The preceding makes us well believe the statement by the manufacturer that he tried literally hundreds of different combinations of parameters before the right combination was found. The final result is a midrange which is flat within 1½ db. It required an 8-in. speaker with a 5½-lb. magnet structure, 1½-in. voice coil, and its own separate-from-the-woofer loading. The upper crossover frequency of 2500 cps was chosen as a good compromise between the major orchestra fundamentals and the increasing importance of dispersion with increasing frequency.

The Tweeter

The major innovation introduced in the XP-10 is the "soft dome" hemispherical tweeter. Usually, hemispherical tweeters have domes made of molded phenolic or spun aluminum, both very stiff substances. The assumption behind these stiff domes is the same as one would have in making a cone tweeter; they require a stiff, light material because of the frequencies involved. Unfortunately, these stiff domes have certain resonances which tend to show up above 10 kc.

The designer of this system reasoned that the hemispherical tweeter is different than the cone tweeter in that it is driven at its periphery so that there is a certain amount of structural strength (like an arch) making it unnecessary to use materials such as aluminum or phenolics. Instead he used a rubber-impregnated cotton diaphragm and achieved the same excellent dispersion and transient properties of the stiffer materials, without the characteristic resonances of these materials. (A patent is pending on the idea.)

Of course, to take advantage of the excellent properties of this tweeter, and to match it to the more efficient cone speakers, a 5½-lb. magnet structure with an air-gap flux density of 16,000 gauss was used. It is interesting to note that the magnetic circuit on this tweeter is more powerful than the circuit on many woofers—but of course this speaker is much, much less efficient.

Performance

In order to gauge the performance of the XP-10, we decided to go through extensive listening tests in addition to the usual microphone pickup tests.

First let us look at what the microphone revealed as far as frequency response and dispersion. The frequency-response curve was essentially flat (within 2 db) from 50 cps (our starting point) out to 16,000 cps. At 30 cps the curve was down 5 db and at 20,000 cps it was down 7 db. The dispersion was constant, within 3 db, over an angle of about 90 deg., which was as far as we measured. We noted that the high-frequency response was unusually smooth, thus corroborating the designer's contention concerning the soft dome. Indeed, our measurement of the midrange also agreed with his statements: it was well within the 1½-db variation he claimed. Beyond that, the unit we tested had a remarkably smooth response curve overall.

The listening tests were the best of all however. (They don't always agree with measurements, as you may well know.) We must report that the XP-10 is truly a step forward in smoothness, transient response, and musical quality. It handled percussion, piano, strings, brass, and what have you, as cleanly and precisely as any speaker system we know. We won't use that hackneyed term "best," because it is a meaningless term when applied to speakers, but we will say it pleased us immensely. You try it.

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AUDIO ETC.

Edward Tatnall Canby



LIVER THAN LIVE

II. The Art of Recording

I had a number of specific subjects in mind when I launched "LIVER THAN LIVE I" last month. At this juncture several of them are still in the ripening stage with no harvest dates yet attached. No use wasting a good heading, however. So let's look at principles. There are no less than three big ones nestling in that title (which is not to be pronounced, please, like "Live it up" nor, for that matter, like "calf's liver").

First, there's "live" in a literal sense. Living, alive. Live music *vs.* recorded. Concert-going *vs.* listening to records. Taped speech *vs.* speech-in-the-flesh.

Then there is "live" in the acoustic sense, as opposed to "dead." Both terms are here figurative, imaginative. Live sound is lively because it seems real and immediate to us, thanks to reverberation. Dead sound is dead—even though it may be technically even more faithful to the written word or the printed musical note—because, lacking in reverb, it sounds unreal, unconvincing; hence lifeless.

Still a third and even more imaginative sense is "live" meaning all that is communicative, imaginative, persuasive in reproduced sound—the content that makes our sound presentations "come alive" in the hearing. To me this is the most important meaning because it refers to the very substance of that communication, that artistic product—that entertainment, if you will—which is the concern of so much of our reproduced sound. Without this kind of liveliness, we couldn't even stay in business.

Crafted

Makes me think of some of the older concepts of that doubtful word, art. Art was simpler in the old days. Two centuries back, for instance, good art of almost any kind was thought of as *outdoing nature*. That was the function of art as they then thought of it. To improve upon nature, via man's ingenuity (Accordingly much that we now call science was then called art—very appropriately. And vice versa—music, for instance, was called a science.)

Could any living human being match the beauty of the Mona Lisa? (We still ask that question, half-humorously.) Could nature's own pastoral sounds, its rustling leaves, twittering birds, gushing waterfalls, purling streams, ever produce such a happy effect upon the imagination as, say, pastoral music by Jean-Phillippe Rameau or George Frederick Handel? Ask the sound-effects engineer! Art was even more effective than nature, its raw material, because art, so to speak was *contrived* (we might say "crafted" or "devised") by sheer human ingenuity; whereas nature, in spite of the Creator, was mostly haphazard and certainly not artistic, unless by accident. Landscapes, sunsets just happen. They aren't contrived.

Art in the old days, was the organization of the materials of nature by man into a concentrated, super-natural expressiveness, far beyond nature itself—the raw material. Nice idea.

Now what else, today, is our present sound recording?

It, too, can achieve effects that are even more impressive than the presupposed original, via its own special techniques of organization for drama. Always we try, at least, to *equal* the impressiveness of the original sound. We don't do it literally (like nature) but, rather, imaginatively, by new and different means, idiomatic to the medium. Those means are "contrived" by man for the desired impact upon the listener, and contrived just as ingeniously, just as industriously, with as much skill, as the nature-improving art of the past.

Stereo can do it magnificiently. (Though bad stereo can botch the job, like bad art, natch.) Stereo recording can make a musical classic "come alive" in its musical impact, and certain aspects of that impact can actually improve upon the original live music, via the sheer art of stereo know-how.

Don't laugh at that idea. It is easily documented. Many a recording today is musically more persuasive in terms of sound, carrying more information as well as more drama, than any possible live performance in practical terms.

After all, a large part of the music we hear was never composed for the modern concert in the first place. And so the recording engineer often is serving as a kind of musicologist; he can re-create on records a much better approximation of the original musical effect than can the harrassed concert director with his "dead" hall and his "live" musicians! We can do a lot better because we can tailor our acoustic effect to match the musical need in stereo terms. Liver than "live"!

Have you ever heard a recital, say, of music for violin and harpsichord in a place like Carnegie Hall? Preposterous. Can't hear a thing. Much too distant. Too much space. Just try the same on records if you want an accurate impression of the real musical intent.

Ever listen to (or worse—*perform*) sixteenth century cathedral choir music in a modern padded-cell concert room? I have, only too often. Absolutely deadly, a perversion of the music to the point of near-extinction. On records, we can do very much better. We choose cathedral acoustics to suit the music. Naturally, I find that my own records of such music are often much more effective, more alive, than our live performances of the very same works. Liver than live.

(From this very point I will take off on one of the specific subjects I have ready for the future—how about a "liver than live" *concert* via artificially induced reverberation? I've already tried out one electronic installation with a few of my singers; we expect to give a whole concert in an artificially live environment later on this month. More on that coming up.)

The Live Original

How about that live original, on which we supposedly pattern our recording? Well, if you mean an original "concert hall" sound, a live concert performed before the obliging recording mikes, taken down as is, then you can discount it. Forget it. Recording just isn't done that way. Most recordings are no longer records of such a concert, even a specially staged concert. Instead, they are re-creations that start further back, not with a concert but from the composer's own score, which is interpreted from scratch with stereo in mind. We may, indeed, *simulate* a concert to some degree—like putting the violins on the stereo listener's left (though they may not be there at all in the studio!). That's enough. We have recording sessions for making records, not concerts.

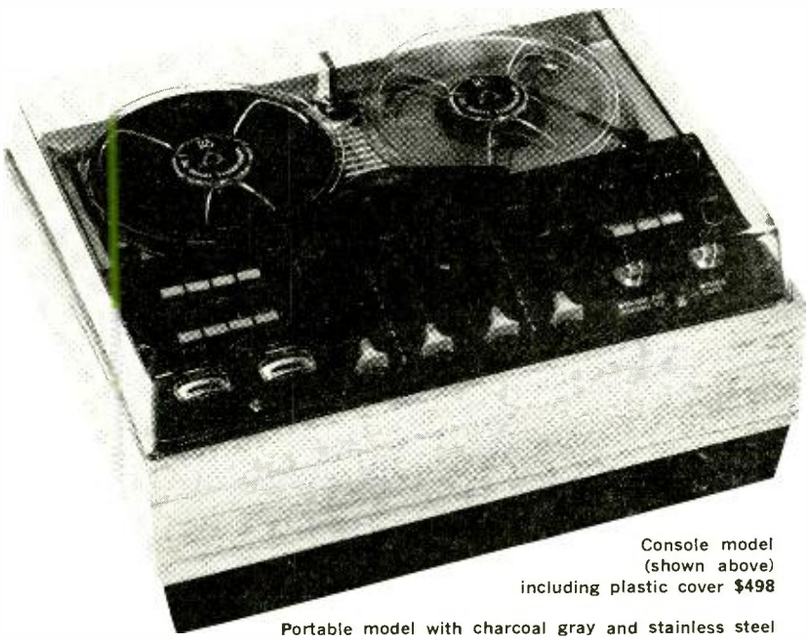
The whole recording process, in fact, is now utterly removed from the thought of concert production and concert sound. Some people groan because of it. Not me! These are the "contrivances" of a real art in the oldest and most dignified sense, I say. From mike placement to tape editing, the techniques are purely artistic—even if the engineers may find that term a bit embarrassing. The ancient discovery of perspective, rendered onto a flat plane, was just such an in-

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1⅞ ips	≤ 0.5%	≤ 0.18% (0.0018)

Values listed are for reproduction equalized according to normal listening weighting (wow frequencies ≥ 4 cps attenuated 3 db/octave $\left(\frac{1}{\sqrt{f}}\right)$.

Channel Separation: better than 45 db.

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¼ track heads

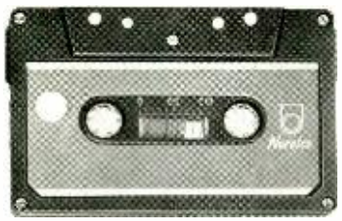
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genious contriving of nature as these newly worked out techniques for stereo recording. I see no real difference. Both raised an ingenious art to an even higher level of ingenuity. What more can you ask?

How about live music itself? Well, it's definitely here to stay. There's nothing that can match cathedral choir music *in a cathedral*—assuming there's one handy. Symphonic music in a fine concert hall can't be beat, nor chamber music in an intimate large room. Nobody, and certainly not myself, can criticize live music in its own domain.

Live music does not merely "have its place," as some suggest with condescension. It remains a primary standard for musical experience and a standard, too, by which we must continue to work in recording—since 99 per cent of the music we record was composed for the live situation alone, recording being quite unintended, or even utterly inconceivable by the composer. Didn't yet exist.

(Only in very recent music, notably in popular, jazz, folk, show music, mood music, is the recorded effect actually a factor in the original concept. Very seldom, yet, in the "classical" area.)

Parallel

That being the practical state of affairs, we must perforce re-create our recorded music, via the new techniques of recorded sound, in a sort of *parallel* with the art of the live presentation, starting from the same original score (though not from a live performance), keeping the live music always in mind as the primary form, yet branching away immediately at the very beginning toward purely recorded effects not really literally like anything live.

That is so much taken for granted now that virtually every live performance which is to be recorded is first, so to speak, re-staged, re-studied from the ground up, the whole production shuffled around to match the recording requirements. Taken for granted, but fundamental to our present understanding of the recorded art.

That parallelism, the essence of good recording, is like the old parallelism between nature and the art of "representing" nature in painting, through so many ages. And if art takes imaginative liberties with nature—it always has—then recording must take equally imaginative liberties with live music! It often does, and we are the better for it.

Being people, recording engineers naturally try to outdo what they have already done and to outdo that again the next time. Naturally, like the good artist-experimenters they are, they keep pushing ahead, learning, becoming ever more crafty and versatile, plugging

(*Continued on page* 84)

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Stratophonic prices: Model SR900 (illustrated), $469; Model SR600, $389; Model SR300, $279. At these prices, practically *everyone* can afford Stratophonic Sound.

SPECIFICATIONS, Model SR900

IHFM music power: 75 watts • Frequency response: 2 to 100,000 cps ±1 db at 1 watt (normal listening level); 5 to 60,000 cps ±1 db at full power • Distortion less than 0.2% • Usable FM sensitivity: 1.85 μv IHFM • All-transistor front-end FM circuit for optimum selectivity and sensitivity • Damping factor: 40:1.

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ABOUT MUSIC

Harold Lawrence

Distortion—Who Needs It?

To accuse a recording engineer of deliberately creating distortion is like saying that he cheats at cards or serves highballs to minors. Distortion is a dirty word to the professional recordist, who is constantly on the lookout for signs of the dread disease. Nothing pleases him more than to produce a clean tape with a wide dynamic range, excellent signal-to-noise, and perfect musical balance.

Despite improvements in electronic equipment and engineering standards, however, distortion is still with us. Sometimes it is the result of carelessness, poor judgment and inexperience. More often than not, the shrieking highs, wild mid-range peaks, thunderous bass, and other sonic aberrations of many pop discs, are produced deliberately. In the competitive world of the 45-rpm single, where a "straight" recording would be as out of place as a lieder singer on a rock-and-roll date, the A & R producer must come up with new sounds to create and satisfy teen-age tastes. If this means distortion, he couldn't care less. He will use superbly equipped studios to bring forth distorted recordings which may make the engineers cringe, but which, he hopes, will provoke squeals of delight from the kids.

How does he go about producing distortion? The most popular recipe calls for overdubbing voice tracks using the same singer. "Even with the best performers," observes Tom Dowd, Atlantic Records' talented recording engineer, "there are changes in intonation and vibrato from one take to the next, and you're introducing phase distortion right away. Suppose you split the overdubbed voices into two separate channels, echo-chamber the first and tape-reverb the second, and you will then have more phase distortion. Finally, you can equalize one and not the other and compound it all."

If the producer is impatient, he can create instant distortion on voices at the first stage of recording. Dowd lit a match. "Standing in front of a microphone is like standing in front of a match. The vocalist sings 'Who.' Now how can 'Who' give you any trouble? A word like 'Peter' (the match fluttered at the P's impact) is an obvious problem. But the *silent* troubles . . ." Dowd lifted his thick eyebrows expressively. "You can eject enough air singing 'this' to blow out a match." Dowd tossed the dead match into an ash tray. "When I record a problem singer I light a candle, put it between him and the microphone, and tell him: 'Go ahead, blow the candle out. But every time you do, we start all over again.'"

Unless, of course, the A & R director likes pops and wind blasts. An engineer in a midtown New York studio had just recorded several Spanish-language spot announcements. On checking the tape, his boss was horrified at the distortion: the pickup was "super-close" and the meter was laying on the pin. The engineer anticipated the question: "I know, it's distorted beyond belief. But this is what the Spanish market wants."

Purely in terms of sound, the 45-rpm singles producer is cousin to the "aleatoric" composer who stumbles upon new sounds through experiments with electronic devices. "Something will go wrong at a session," Dowd continued. "It will be a certain combination of mikes, a bad connection, some technical mishap. The engineer will spot the trouble and say, 'Don't worry, it's all right. Give me a minute and I'll save it.' But the A & R man at his side, who has no technical knowledge, will grab the engineer by the arm and say, 'Leave it alone. It sounds great.' Knowing it's against every engineering principle he's been trained to follow, the engineer acquiesces. He resigns himself to putting every bit of technical knowledge, right or wrong at the producer's disposal."

Distortion by design occurs more frequently than chance distortion at pop sessions, partly because the latter requires a spirit of playfulness and a willingness to stray from a pre-conceived sonic plan. Sid Feldman (Mastertone Recording Studios) describes a typical example of deliberate distortion, relentlessly pursued. "The producer of this rock-and-roll session started out by overloading the bass track. The engineer gave him 8 db more bass. At the mix, the producer wanted still more bass. At this point you could hardly hear the voice track! A dub was cut from the master tape and, again, he was unsatisfied. More bass was added. By now, the engineer had to limit like crazy in order to be able to cut the disc. At last, the client was pleased: 'Man, *that's* the sound I want!'"

Since the advent of magnetic tape, many new record firms have sprung up across the country, set up operations on a shoestring, and still make recordings under primitive conditions. Sometimes one of these small labels scores a hit with a 'new sound.' "Lack of facilities is often the factor that gives birth to this new sound," Dowd pointed out. "Put a 15-piece orchestra in an 8×10 studio with one distorted microphone and it's not hard to imagine the results. But if one of these labels comes up with a hit, watch the others try to duplicate the distorted sound of the original. Conversely, a would-be record producer will visit a friend who has some professional equipment and tape a few tunes in what he thinks is a 'commercial' sound. He will use hit records as the pattern for his own recordings. He will want the drum to sound like this, the bass like that, but without understanding why, he can't quite make it. And he ends up settling for something else. In the process, he may stumble upon a combination of sounds that somehow appeals to the public. Suddenly the industry is now trying to copy a flawed imitation of existing hit-sonics."

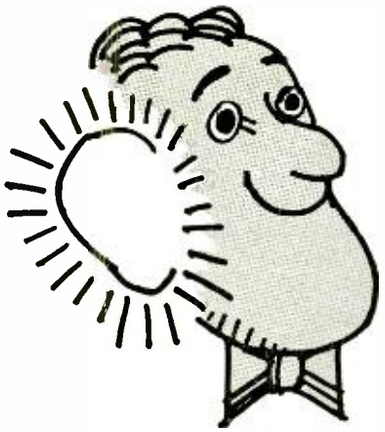
Most record producers avoid distortion. Those who employ the vocabulary of distortion, consciously or otherwise, do so without guilt feelings. "Sometimes we distort sounds to confuse people," said A & R director Bob Crewe. "I like nothing better than to have someone ask, 'What was that?'" Many pop singles producers are sophisticated in the use of electronics and look down their noses at their more intuitive colleagues. "Abnormal sound that's intended to be abnormal is right," Archie Bleyer stated flatly. "Abnormal sound that you can't avoid because you can't get normal sound is wrong."

Distortion is here to stay in all branches of art. In photography, for example, the ultra-wide angle lens and the cultivated "blur" are common. Electronic music abounds in distortion. Distortion in perspective is as ancient as the cave man. Some of us, though, will never accept distortion in sound reproduction.

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GOLDENEARS AND THE THREE SPEAKER SYSTEMS

Once upon a time, Jason Goldenears was wandering through the city in search of a miracle. To be precise, he was looking for a moderately priced speaker system free of distortion, coloration, peaking and boom.

He was not having an easy time of it. If his super-sensitive appendages could not hear the bowing of



the bull-fiddles, if brass did not bite, if drum-beats were heard as a blurred roll instead of well-separated beats, he sneered. He was an acoustic malcontent.

Because of his limited budget, he had been listening to dozens of "bargain-priced" off-brand systems. Now, sadder but wiser he vowed: "I will no longer shop for price. If necessary, I will sell the children into white slavery."

In the very last store he entered he was met with a sound to delight the ears. "You're listening to the University Classic Mark II," said the dealer. It was magnificent, thought Mr. Goldenears, and looked it, too, in its new Provincial cabinet. Though only $325, it exceeded his modest budget. Nevertheless, had he felt that his small living-room could accommodate two Classics, our story would be over. "The devil take middle-income housing!" thought Mr. Goldenears.



The dealer, apprised of his problem, said, "I have exactly what you're looking for. Listen!" And he began to demonstrate the new University Medallion Monitor.

"Yes," mumbled Mr. Goldenears as he listened to it. "No distortion, no coloration or peaking. Instruments clearly defined. And feel that bass."

"25 to 40,000 cps," said the dealer with a smug little smile. "It can fit on a shelf and," he paused dramatically, "it's only $129!" *This one was just right!*

"I'll take two, if you please," said Mr. Goldenears, and it was done.

Almost, that is. On the way out, he heard the new University Mini-Flex II. Only 15" x 9" x 6", but it sounded so big! And no distortion. Perfect for the bedroom! Certainly, it was superior to larger and costlier systems he had heard. But could he afford it?

As if he had read his mind, the dealer said: "It's only $49.50. And it carries University's exclusive five-year warranty, just like the Classic and the Medallion Monitor."

And so Mr. Goldenears bought two Medallions, one Mini-Flex, and lived with them happily ever after.



For the complete story on all the "Goldenears-qualified" speaker systems, send for the new University catalog and the 1964 Component Stereo Guide. *Write: Desk R-11, LTV University, 9500 West Reno, Oklahoma City, Okla.*



Renowned Classic Mark II, 15" three-way speaker system in its new Provincial cabinet. Fruitwood, $325. Modern (oiled walnut), $295.00.



New Medallion Monitor, 12" three-way professional monitor bookshelf speaker system. Oiled walnut, $129.00.

New Mini-Flex II, ultra-compact three-way speaker system. Oiled walnut, $49.50.



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EDITOR'S REVIEW

IT IS TIME TO START ANEW

LAST MONTH we reported briefly concerning the rapidly increasing changeover to transistors in component electronics. Another strong trend which we were unable to report about (lack of time and space) is the large number of "less expensive" speakers being introduced. Apparently speaker manufacturers are trying to fight back against those no-name no-sound speakers we mentioned in a previous editorial. Certainly the major feature of this new crop of speakers is reduced price; they are definitely not improvements in sound over previous models made by the same manufacturers.

We think that this attempt to fight shoddy products by reducing performance is a tragic mistake; it is the very antithesis of what high fidelity components stand for. We are not intimating that these new speakers are necessarily bad, in fact most of them are remarkably good, everything considered.

But the direction is wrong.

Manufacturers are concentrating a major portion of their energy on making the best possible speaker to sell for less than XY dollars. In the past the concentration was on making the best possible speaker. Naturally there were, and are, economic limitations on this approach too, but the compromise never permitted quality below a certain good level. The present approach, however, implies an abandonment of that proposition; it seems to embrace a "package goods" philosophy of making the quality fit the price. It seems to us that the very reason for existence of the component high fidelity industry was a revolution against the "package goods" approach.

Thus we must conclude that the present trend toward price rather than quality competition may well spell the end of the component high fidelity industry as it exists today. We are *not* predicting the disappearance of components, but rather a parting of the ways. Some manufacturers now making high fidelity components are either going to make "package goods" only, or leave this field entirely. Others are going to return to the practice of quality manufacturing (the approach, that is). Of course there are some who have never stopped making the best products they know how to make, and let the price fall where it may.

We say it is high time the trend was changed, the time for separating the "package goods" philosophy from the component philosophy.

IT IS TIME TO START ANEW!



PARAMOUNT ORGAN SAVED

Many theater-organ enthusiasts have been concerned about the fate of the "Mighty Wurlitzer" which has occupied the Paramount Theater for many many years, now that the building is to be demolished to make way for "progress." We were notified recently that through the good efforts of the Wurlitzer Company and a West Coast group spark-plugged by Richard Simonton, this famous organ, which Jesse Crawford used to reach stardom, will be installed in a theater in Los Angeles. After it is properly installed and refurbished it will be used, as in the past, to accompany silent movies.

It is good to hear of things like this where beloved and valuable bridges to the past are preserved, and put to good use.

EUROPEAN AUDIO EVENTS

Audio-minded readers (do we have any other kind?) are always curious about hi-fi and electronic shows and exhibitions, even though they may not plan on visiting them. On the other hand, manufacturers are vitally interested because they recognize new market possibilities. During the next few months, the following events are scheduled in Europe and Great Britain:

Paris: Festival of Sound, March 11 to 16—a well planned and produced hi-fi show from which many pointers could be gleaned by other show impressarios.

Also Paris: International Exposition of Electronic Components, April 8 to 13—a massive show similar to our own IEEE exhibit in March.

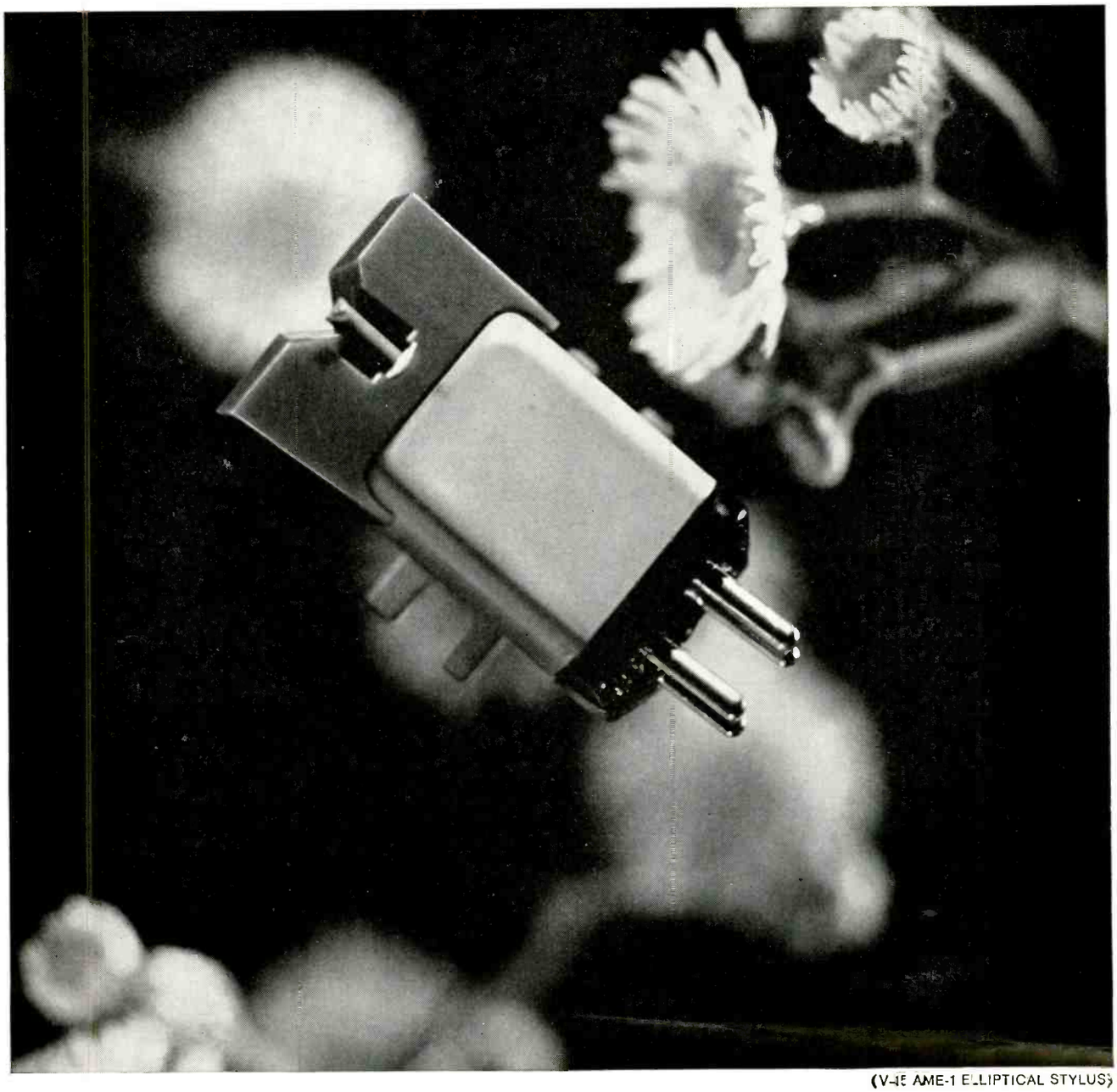
London: International High Fidelity and Music Show, April 22–25. Again being held in Hotel Russell, and still under the direction of Cyril Rex-Hassan. Don't miss it.

(XXXXXX.....Y)

We didn't exactly see one of the demonstration kit builders do what this young lady is doing, but we have often speculated that they must feel that way from time to time. We have built enough kits (undoubtedly more than most people) so that we can well understand that peculiar frustration when something just doesn't go right; a defective tube, a part missing, mechanical difficulty in mounting parts, we have experienced all of these and more. At those times we felt like doing just what the cartoon shows.

And screaming (XXXXXX . . . . . Y)!

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Should Sherwood's new solid-state amplifier be rated at 150 watts?...300 watts?...or 100 watts?

Audio power *should* be one of your major criteria of amplifier performance. The important thing is to use the same yardstick of comparison.

Among responsible component manufacturers, the commonly-accepted expression of audio power today is "MUSIC POWER"—the amplifier's output capability across the full spectrum of orchestral sound.

If you simply like to play with bigger numbers, multiply MUSIC POWER by two (the way some manufacturers do) and you get "PEAK POWER". It's exactly the same rating but it *looks* twice as powerful.

But the really important measurement is "CONTINUOUS SINE-WAVE POWER" with both channels operating simultaneously. This is the *meaningful* measurement, used in laboratory work. It separates the wheat from the chaff.

Sherwood's new S-9000 delivers 150 watts of MUSIC POWER . . . 300 watts of PEAK POWER . . . and 100 watts of CONTINUOUS SINE-WAVE POWER at less than ½% harmonic distortion. (At normal levels, distortion never exceeds 0.15%).

Unequalled power—by *any* standard—is just one of the important engineering advances built into the new Sherwood solid-state amplifiers. Here are some more:

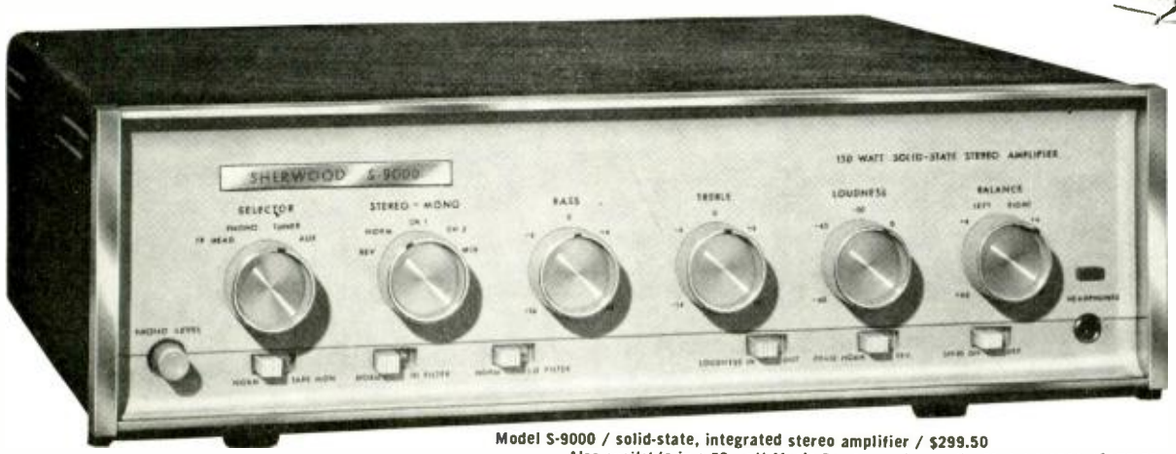
Military-type Silicon Transistors. Used exclusively throughout Sherwood circuitry. Twice the heat-reliability of ordinary germanium transistors. Safe for even the most confined custom installations.

Exclusive transistor short-circuit protection. (Pat. Pend.) New system virtually eliminates transistor failure or fuse replacement due to shorted speaker terminals or other improper operation.

Additional features: Phono input noise less than −65db., with no microphonics or hum / Professional Baxandall tone controls / Tape monitoring and tape-head playback facilities / Stereo headphone jack with speaker disabling switch / Glass epoxy circuit boards / Compact size—14" x 4" x 12½" deep.



Wait till you hear Sherwood's new Tanglewood 4-way speaker system! Each six-speaker system handles 75 watts of program material. Unique design of dual, 10" uniflex woofers achieves unprecedented 34-cycle closed-box resonance. Overall response: 29-17,500 cps ± 2½ db. **$219.50**



Model S-9000 / solid-state, integrated stereo amplifier / $299.50
Also available in a 50 watt Music Power version as the Model S-9500 / $179.50
Walnut-grained leatherette cases for either model, $8.50 Prices slightly higher in Far West

For complete specifications and new catalog, write Dept. A-11 — Sherwood HIGH FIDELITY

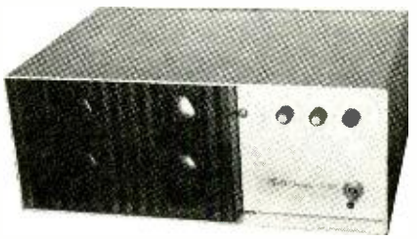
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The El Cheapo 2-30

R. R. MOORE



A versatile stereo power amplifier using silicon transistors. Changing the output configuration boosts the power output by 50 per cent.

A NUMBER OF ISSUES AGO, Myers and Kahn presented an article in AUDIO describing a high-power, high performance audio power amplifier using silicon output transistors. The article presented an excellent design, and included was a warning to readers that duplicating this amplifier could be an expensive and troublesome job. Feeling that most AUDIO readers, myself included, are capable of building successful projects, I plunged into an amplifier building session that lasted several days, and left relatively few scars.

The Amplifier

The amplifier that Myers and Kahn described utilizes a circuit long familiar to perusers of The *General Electric Transistor Handbook*. The amp is direct-coupled (up to the speaker) and uses large amounts of negative feedback, both a.c. and d.c., and from Q_2 on, is an operational amplifier of the form shown in *Fig.* 1 where voltage gain equals R_f/R_{in}. The output stage is the now-familiar circuit described by Lin, which I can't seem to help calling a "push-push."

Using Myers' and Kahn's article as a guide, I plowed around in my spare parts, gathered transistors, 'scopes, oscillators, and regulated supplies, and set to work. The schematic of *Fig.* 2 is the result.

The choice of silicon output transistors is a natural from virtually every standpoint; better performance at high temperatures than germanium, along with less chance of "tunnelling through"; reasonable cost; and higher (in most cases) F_t than germanium. My breadboard amp, and for that matter, the amp from which the specifications come, uses 2N1488's, a less than ideal choice, due to a fairly high saturation resistance, and an almost $8 cost. Recently, the 2N3055 came along, with a very much lower R_{sat}, and lower cost, too. This transistor is rated at 115 watts, and is really pretty nifty.

The beauty of this amp, to me, is that several options are available to the home builder. The maximum power output may be chosen at will, to satisfy various needs, without affecting the performance in any negative way. The high-frequency response may be adjusted to taste; and, within limits, the input sensitivity may be adjusted to meet individual needs.

Output power: The factors affecting output power are power supply voltage and the current limitations of the output stage. Let's cover supply voltage when we discuss the power supply. The output-stage current limitation is defined by the transistors used. Assuming that the transistors are operating within their voltage ratings, the usual current limit is imposed by the increase of junction temperature. Here, however, we must also be concerned with the function of Beta *versus* collector current. The 2N3055's hold Beta quite well up to several amperes of I_c, insuring good transient response at high currents. However, at output powers above twenty watts, especially into 8-ohm or lower loads, parallel operation of the output stage is highly preferable, to keep Beta high, and junction temperature low. *Figure* 2 shows the changes; addition of a pair of transistors, and emitter resistors which provide enough degeneration to equalize the differences in members of pairs. Parallel operation is more expensive, but the cost is justified if high power is needed for long periods. If the amp is to be used for music reproduction, then even high supply voltages and high power output may be safely handled by a single pair of output transistors.

Risetime: If a 'scope and a pulse generator with a 10kc or thereabouts reprate are available, the rise time of the amp may be tweaked to most anything desired, in the range of two to six microseconds, by making C_f variable. An 8-50 pf trimmer in parallel with a 39-pf "dog-bone" will cover most of the range. More C may be needed to really slow the amp down. Some overshoot may be encountered if too little C is used in an attempt to speed the amp up. The test pulse should have a rise time of 200 nanoseconds or better, so as not to affect the display.

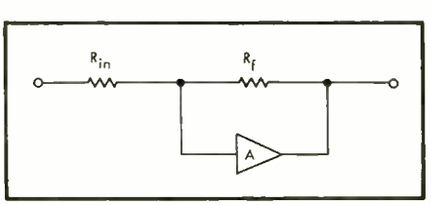


Fig. 1. Operational amplifier configuration.

Sensitivity: With the help of an AC-VTVM, or 'scope, and an audio signal generator, the input sensitivity may be adjusted. R_{in} and R_f may be pots, which will have values of 10k and 50k respectively, and can be whatever taper is handy. Linear taper is best if the pots are going to be built in. The idea is to select first the amount of feedback that is desired in the main loop, and then decide what sensitivity is needed, that is, how many volts in, for how many volts out; then, multiply the closed-loop gain (R_f/R_{in}) by the feedback factor to find the open-loop gain required. Set R_{in} to give the required gain with the loop open, then hook up the main loop, and tweak R_f to give the final gain. I had decided that 15 db of feedback in the main loop was a neat amount (although the amp will handle very large amounts), and I had decided that the amp should develop full power, 16v rms into 16 ohms, with a one-volt rms input. My closed-loop gain needed to be 16, and since I wanted to use 15 db of feedback, the open-loop gain needed to be $16(15\text{ db}) = 16(5.62) = 90$. I applied a 1kc, 50 mv signal, and adjusted R_{in} for an output of 4.5v. I conected the main loop, and using the same input signal, I adjusted R_f for an output of 800 mv. The values turned out to be 1k and 18k, to the nearest standard values. To obtain high output power, some input sensitivity must be sacrificed, or some feedback, whichever is the least objectionable.

If you have a transistor preamplifier with emitter-follower outputs, stage Q_1 can probably be eliminated, with attendent savings in parts and transistors. If, on the other hand, you have collector outputs, or a Fleming valve amp (perish the thought), Q_1 should be retained, as Q_2 needs a current drive with a large coupling cap. Without Q_1 the input impedance of the amp is quite low, equal to R_{in}, and the coupling caps in your preamp will seriously roll off the low-frequency response. If your preamp will tolerate the small value of load imped-

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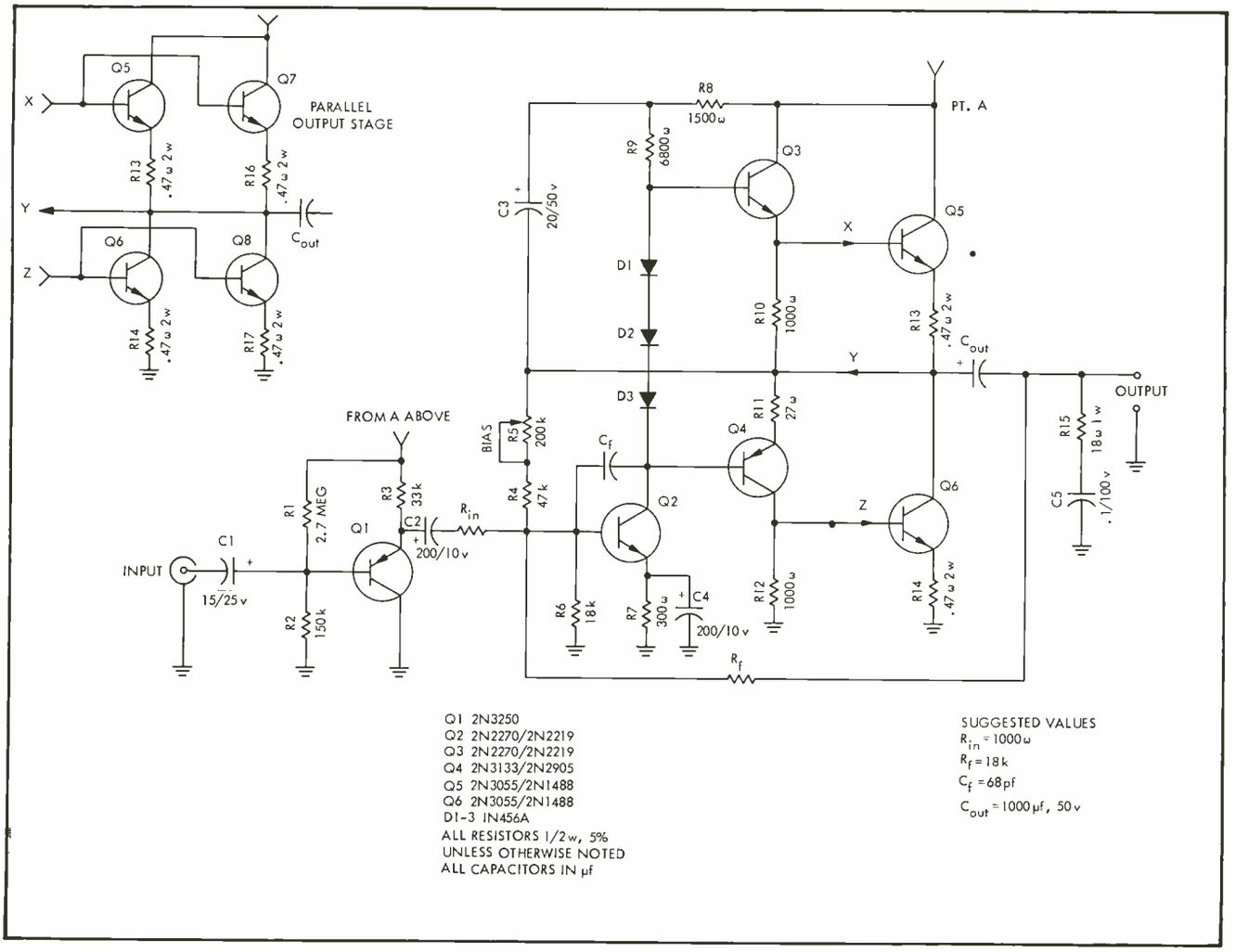
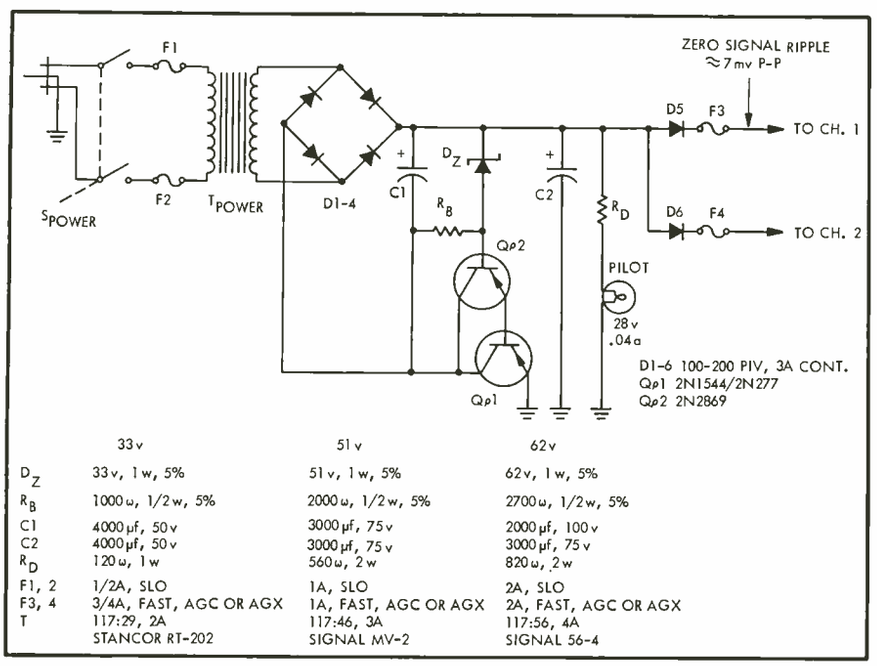


Fig. 2. Schematic diagram of power amplifier, plus changes necessary to achieve higher power.



	33v	51v	62v
D_Z	33v, 1w, 5%	51v, 1w, 5%	62v, 1w, 5%
R_B	1000ω, 1/2w, 5%	2000ω, 1/2w, 5%	2700ω, 1/2w, 5%
C1	4000µf, 50v	3000µf, 75v	2000µf, 100v
C2	4000µf, 50v	3000µf, 75v	3000µf, 75v
R_D	120ω, 1w	560ω, 2w	820ω, 2w
F1, 2	1/2A, SLO	1A, SLO	2A, SLO
F3, 4	3/4A, FAST, AGC OR AGX	1A, FAST, AGC OR AGX	2A, FAST, AGC OR AGX
T	117:29, 2A STANCOR RT-202	117:46, 3A SIGNAL MV-2	117:56, 4A SIGNAL 56-4

Fig. 3. Power supply schematic.

ance, or if you desire the low-frequency roll off, you might be able to substitute larger caps for the ones present in your preamp. You might have to fiddle a little with the time constants.

The Power Supply

One of the first requirements in power supply design is that imposed because the amplifier designer usually assumes the availability of ideal sources of power, having zero impedance and perfect regulation. The downfall of many otherwise excellent commercial amplifiers, for my part, is the lack of regulated power supplies. Some manufacturers use very large power transformers to give some regulation, and the general use of low-impedance rectifiers has helped tremendously. But the best of these combinations can do nothing about changes in line voltage, and the worst can offer no regulation of any kind. The answer is, of course, regulated supplies, with the obvious rewards of lower hum, and greater stabilization of operating points. *Figure* 3 shows a regulated supply that powers two of the amps in *Fig.* 2. You'll notice that the

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regulator has to look through the rectifiers to see the load, which isn't the ideal way to have things. But this is the ideal place for germanium power transistors, for we can use their high Beta and high current capabilities here. Q_{p1} and Q_{p2} are in the familiar Darlington connection, and give very good regulation. Q_{p1} should have at least a 40-watt rating, and Q_{p2} should rate at least one watt. Both should have the highest Beta possible, at least 50, and over 100 preferably.

As mentioned earlier, output power is set by supply voltage, which is determined by the zener voltage of D_z. Supply voltage may be changed by changing the zener diode, and its dropping resistor R_D, which sets the zero signal current through the zener. Using the 62v supply, you can probably get 30 watts per channel into 8 ohms, possibly more. Likewise, output power may be reduced by lowering the supply voltage. If 10 watts per channel is enough, and I suspect that it is for most of us, a 33v supply will do the job. In any case, the no-load d.c. output from the rectifiers should be about 20 per cent higher than the regulated supply, to allow for line variations, and squashing of the transformer output under heavy load. The *Motorola Zener Diode and Rectifier Handbook* gives an excellent design procedure for this type of regulator in Chapter Three. *Fig.* 3–9.

Output power greater than 30 watts is easily obtainable from the amps, but as power goes up, so does the current that the regulator supplies, and it may be necessary to use a more elaborate regulator to maintain regulation for two channels. Finding a transformer might be a problem also. There are selenium rectifier transformers readily available, for use with the 33v and 62v supplies. For the 51v supply, or higher voltages, it will probably be necessary to series stack two transformers to obtain the required voltage.

The table in *Fig.* 3 lists the various values of parts for the different supplies. The values of the capacitors are minimum-but-adequate. The BV_{ceo} ratings of Q_{p1} and Q_{p2} need not be much higher than the zero signal drop across Q_{p1}, as the regulator follows the charging of C_1 easily. The pilot lamp, an incandescent unit, was chosen instead of a neon lamp, because it serves to bleed the supply very rapidly when the power is switched off.

Construction

The construction of this amp, while no job for the novice, isn't the least bit critical. Q_{p1} and the output transistors should be well heat sunk. The large variety of heat sinks on the market, most anodized and pre-punched, take the pain out of this. If you are building for high power, it might not be a bad idea to use heat sinks of some sort on Q_2, Q_3, and Q_4. D_1 through D_3 in the amplifier may be most any silicon diode with a rating of 100 mA or more, and with a reasonably small leakage. The amplifiers and power supply lay out very nicely on printed circuit board (see *Fig.* 4), either breadboard or photo etched. I grounded circuits where it was convenient, but due to the high currents involved, it may be necessary to fool around with ground runs to find the points of least noise. I would avoid using common ground busses of any sort. A good method is to ground at the point of least signal, and run each point to be grounded via a separate bus to this point. Unless the feedback components are made variable, the only adjustment in the amplifier is the setting of the 250k bias pot. This pot should be trimmed for symmetrical clipping of a sine wave at the output. If you don't have a 'scope, or one isn't available, the pot may be set so that one-half the supply voltage appears at the collector of Q_6. It is desirable to trim the pot at clipping, however, and it would be worthwhile to have it done, if you can't do it. Much reference has been made to test equipment in this article. If the parts list is followed, and the suggested values used, no test equipment is necessary to achieve excellent results, outside of a VOM.

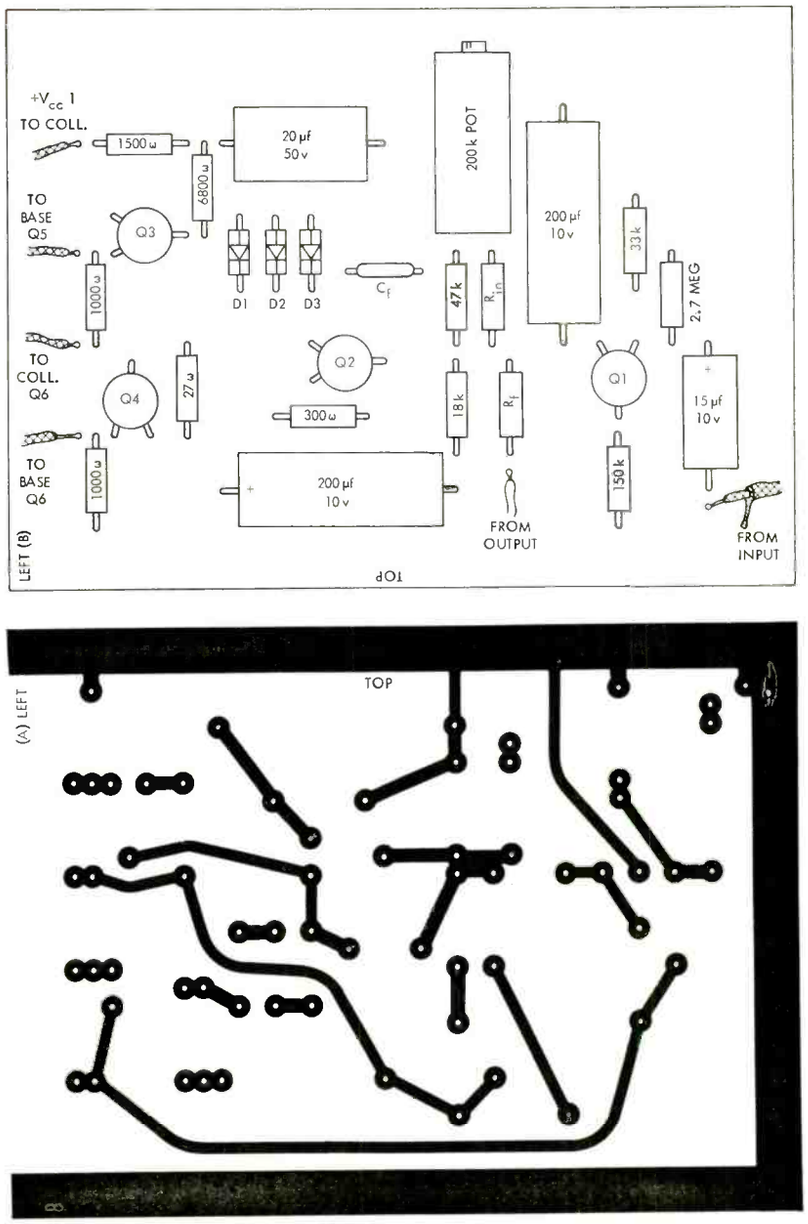


Fig. 4(A) Printed circuit board for one amplifier (foil side shown); (B) parts placement. Note location of top and left

Performance

The specifications, I feel, describe an excellent amplifier. If first grade components are used, I feel that the amp will

(Continued on page 87)

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The "Dynagroove" System

HARRY F. OLSON*

Now that "Dynagroove" recordings have been available for sometime, we can re-examine the basic premises and compare them with the results. "Dynagroove" is a systems approach, embracing the development of elements as objectively perfect as possible combined with an idealization of the recordings by means of appropriate compensations based upon the subjective considerations of the pickup and listening conditions. Judgments are made as musically correct as can be by involving the artist in critical areas.

In Two Parts—Part One

IN THE RCA Victor "Dynagroove" project the artist, scientist and engineer have worked as a team[1,2] to produce the maximum artistic impact upon the listener in the home. From this precept, the obligation of the recording process is to recreate in the listener's mind, first, a vivid recollection of his live experiences while he is listening in his living room, and second, to give him a realistic musical experience with every type of music whether he has had the live experience or not. This is the frame of reference and it is this set of conditions that are involved to prescribe the ingredient of a recording if it is to justify its existence. To bring these conditions about, studies of the music and rendition of the music by the artist have been carried out by the artist, musician, musical director, recording engineer and scientist.

The collaboration of the artist and the scientist-engineer is depicted in *Fig.* 1. The artist and scientist-engineer team developed the over-all plan, arranged the musical instruments, worked out the placement of the microphones, monitored the reproduced sound in the listening room and recorded the master tape as depicted in (A) of *Fig.* 1. In the next step, as a result of extensive subjective studies and tests, the team developed the Dynamic Spectrum Equalizer. They worked together to monitor and produce the submaster tape as depicted in (B). The original lacquer is recorded from the submaster tape as shown in (C). In this process they monitored the signal used in cutting the original lacquer disc. They checked the disc record produced by the process shown in (D) in a typical living room (E). They also collaborated in determining the environment and listening habits of the consumer-listeners.

* *RCA Laboratories, Princeton, New Jersey.*

[1] D. Sarnoff, "New Developments in Electronics," Address at the Annual Winter General Meeting, American Institute of Electrical Engineers, January 31, 1955, New York, New York.

[2] John Pfeiffer developed and implemented the artist-scientist team plan of action in the "Dynagroove" project.

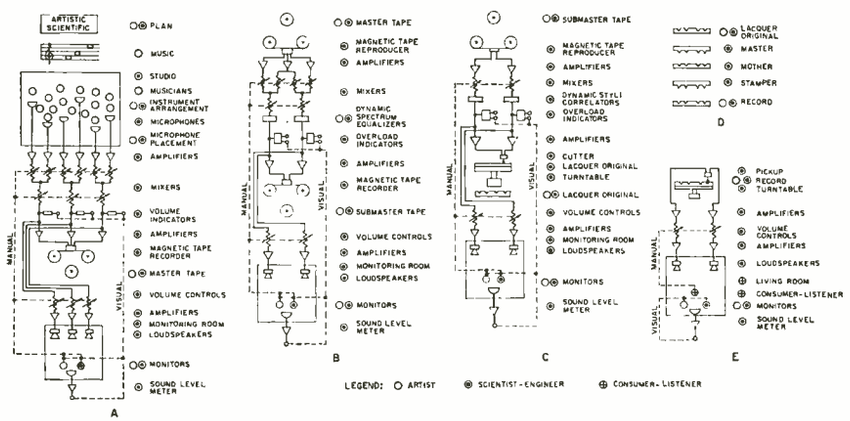


Fig. 1. "Dynagroove" system: (A) System for producing the master tape; (B) system for producing the submaster tape; (C) system for producing the lacquer original disc; (D) processes in the production of the record from the lacquer original, (E) system for reproducing the record in the home.

Sound Sources and Studios

The characteristics[3] of a musical instrument vary with the manner in which the instrument is played. The type of execution and rendition of a musical number differs in the recording for reproduction in the home as contrasted to that employed for a live performance. In addition, the recording environment is substantially different from the environment of a live performance.

When an artist or musical aggregation performs in a studio or hall there is at any observation point the direct sound from the source and the reflected sounds from the boundaries of the enclosure; the studio plays a very important part in the recorded sound. Accordingly, a very intensive and penetrating examination of the characteristics[4] of studios has been carried out. The main objective has been to provide the ideal growth and decay characteristics and a smooth response frequency transfer characteristic.

In the past, the characteristic which was thought to provide the most significant information on the acoustics of an enclosure has been the decay characteristic. However, studies have indicated that the growth characteristics are more important. The relative importance of the reflected sounds decreases with each reflection because the intensity decreases with each reflection due to absorption at each encounter with the boundaries. The delay between the direct and reflected sound increases with the number of reflections. As a result, from a communication theory standpoint, the first reflections carry more information than the higher order reflections and therefore play a more important part.

[3] The characteristics of musical instruments will be found in Olson "Musical Engineering," McGraw-Hill Book Co., New York, 1952.

[4] The development of the acoustics of recording studios for the "Dynagroove" Project was carried out by John Volkmann.

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Fig. 2. An interior view of the RCA Italiano recording studios in Rome, Italy.

The transfer characteristic from a sound source to an observation point is another important criterion which shows the anomalies in the sound pickup system. The envelope of the transfer characteristics should be smooth and free of sharp spikes or dips. Such marked deviations will produce frequency augmentations, diminutions, or discriminations in the sound which is picked up and recorded and are therefore undesirable.

The interior of one of the studios[5] incorporating the advanced acoustical design principles outlined above is shown in *Fig.* 2.

Microphones

There are three characteristics that are most important in the performance of a microphone: the frequency response, the directivity pattern, and the nonlinear distortion.

The frequency response of the microphone should fall within the limits of amplitude and frequency as shown in *Fig.* 3 in order to provide pickup of sound with negligible frequency discrimination.

The directivity pattern should be uniform with respect to frequency in order to prevent frequency discrimination in the direct and reflected sounds. If the pattern for two frequencies varies there will be frequency discrimination of a severe order in both the direct and reflected sound arriving from points removed from the axis. Therefore, the directivity pattern of a microphone should fall within the limits on amplitude and angle as shown in *Fig.* 4.

The nonlinear distortion in a microphone should be less than 0.1 per cent for a level of 120 decibels over the frequency range of 30 to 15,000 cps.

The microphone placement with respect to the sound sources plays an extremely important part in the subjective aspects of the reproduced sound in the living room. A studio and living room system are shown in *Fig.* 5. The sound sources and the microphone placement in the studio are studied by means of listening tests in a typical living room.

The fundamentals of stereophonic sound reproduction as applied to the experiments of *Fig.* 5 listed in the order in which they become apparent but not in the order of importance are as follows: sound location, separation and identification of tone qualities, and room acoustics. These three items constitute the elements of auditory perspective.

Subjective tests were carried out by means of the system shown in *Fig.* 5 to establish sound location, separation and identification of tone qualities, room acoustics and reverberation in relation to the placement of the microphones and the location of the sound source. It is beyond the scope of this paper to provide a detailed description of the subjective aspects which have been reported at considerable length elsewhere.[6,7]

Equipment

The design of amplifiers for use between the microphone and the mixers may appear to be so straightforward that very little attention is required for this element of the system. However, many amplifiers in this part of the chain have been found to be overloaded particularly on sound levels of the order of 120 decibels which may occur on close pickup of some musical instruments. Accordingly, low distortion microphone amplifiers have been designed and employed in "Dynagroove" recording.

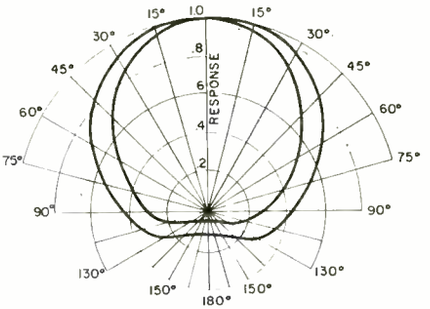


Fig. 4. Limits for microphone directivity response.

A new type of recording console[8] has been developed for the recording of the master tape records. The main objectives have been to provide the maximum ease of operation. Special peak recording volume indicators are used to insure that the tape is not overloaded.

In a magnetic tape recorder the element which determines the overload of the system should be the magnetic tape. An examination of the transfer characteristic of the amplifier, heads and tape, was carried out. The indications were

(*Continued on page 73*)

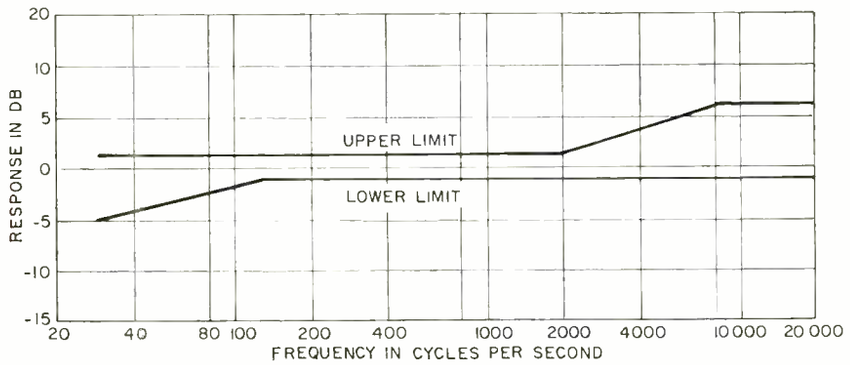


Fig. 3. Upper and lower limit characteristics for microphone response.

[5] B. Bolle, H. Voldner, A. A. Puller, A. Stevens and J. E. Volkmann, "The New RCA Italiano Recording Studios in Rome Italy," *Journal* of the Audio Engineering Society, Vol. 11, No. 1, p. 80, January, 1963.

[6] H. F. Olson, "Stereophonic Sound Reproduction in the Home," *Journal* of the Audio Engineering Society, Vol. 6, No. 2, p. 80, 1958.

[7] H. F. Olson and H. Belar, "Acoustics of Sound Reproduction in the Home," *Journal* of the Audio Engineering Society, Vol. 8, No. 1, p. 7, 1960.

[8] The development and design of the Transfer Master Recording Console was carried out by D. L. Richter.

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An Electronic Organ Design

WINTHROP S. PIKE

IN TWO PARTS—PART TWO

READERS OF MY EARLIER ARTICLE, "Organs and Organ Music" will remember that I stated therein the requirements for a minimum two manual organ. Such an instrument has four major features:

1. A robust Primary Chorus associated with one manual.
2. A Secondary Chorus of somewhat different timbre associated with the other manual.
3. An adequate Pedal Organ with 16-ft., 8-ft., and 4-ft. stops.
4. As many solo combinations and suitable balancing accompaniment tonalities as possible.

In addition to these, a celeste stop, solo reed stops and chorus reeds are required in some types of music but are less essential, if no less satisfying. As stated in the first part of this paper, I believe these requirements can be satisfied with two to five ranks of oscillators. The lower figure would represent a minimum instrument, the upper, a deluxe organ of considerable scope. Let us develop a stoplist for the two-rank version first. then show how it may be progressively expanded.

Principals and Flutes are the "meat and potatoes" of any organ. As few well balanced meals would start with the dessert, let's lay a solid foundation first. Suppose we start with a unit Principal rank of 85 oscillators and a unit Flute rank of 97 oscillators. These might be made playable on two manuals and pedal as shown in Table I, which represents the first phase of construction of the instrument.

A great deal of real music can be made with his two-rank organ. Note the variety of pitch levels available on each manual. Too many commercial electronic organs provide a reasonable number of such mutation stops on the Swell, but no more than a solitary 2-ft (if that) on the Great. This is not right; properly contrasting choruses of adequate brilliance must be available on both manuals. The 1⅓-ft. and 1-ft. stops here provided will be found very useful for brightness and color. Both will "break back" in the top octave as would such stops in a pipe organ. I have omitted the Tierce, 1⅗-ft. as I dislike the sound of this stop when it is derived from a unit rank. It could be added easily.

TABLE I

First Stoplist

Manual I (Lower)	Manual II (Upper)	Pedal
8' Principal	8' Principal	16' Gedact (Flute)
8' Flute	8' Flute	8' Principal
4' Principal	4' Principal	8' Flute
4' Flute	4' Flute	4' Principal
2-2/3' Twelfth (Prin.)	2-2/3' Nazard (Flute)	4' Flute
2' Fifteenth (Prin.)	2' Fifteenth (Prin.)	
1-1/3' Larigot (Flute)	2' Piccolo (Flute)	
1' Sifflote (Flute)	1' Sifflote (Flute)	

Voicing Controls (2)
Flute Mute (stop Tab and Potentiometer)
Principal Mute (Stop Tab and Potentiometer)
Expression Pedals
One, affecting entire organ

By using the resistor, Zener diode, or multiple bus bar scheme outlined previously, the higher pitched stops and the off unison voices (2⅔-ft., 1⅓-ft.) can be voiced with lower levels without the need for rolling off the treble end of either rank. I would suggest three levels for the Principal, the 8-ft. and 4-ft. sounding at the highest level, the 2-ft. at an intermediate level and the 2⅔-ft. at the lowest. Four levels may be required for the Flute; the best arrangement would have to be found by experiment.

As to the timbres of the two ranks, the Flute must not be too dull. It must have some harmonic content, else it will be nauseatingly cloying. The oscillator shown in (A) of *Fig.* 3 is one which is simple and good. In tone it is somewhat like the pipe organ Spitzflute without the wind noises of the latter. The Principal oscillator of (B) in *Fig.* 3 is also quite satisfactory. Its attack control filters should have slightly different (longer) time constants, note for note, than those of the Flute rank. This refinement is surprisingly effective.

The "voicing" controls specified in Table I are unconventional. They would be impossible in a pipe organ. Each is envisaged as comprising a stop tab on the console name board with a small knob-controlled potentiometer directly over it. With the "Mute" tabs off, each rank would sound at its normal level, pre-set by a screwdriver adjustment inside the console. Depressing a "Mute" tab would insert its associated potentiometer into the circuit to permit a limited range downward adjustment of the level of the rank affected. By this means one could pre-set a lower level on either or both ranks. This could instantly be brought into play by depressing the appropriate "Mute" tab. The original level could instantly be restored by the reverse action. Flicking a stop tab on or off is often possible even in a rapidly moving piece of music, whereas the more sophisticated action of setting a knob to a precise position is out of the question. This inexpensive artifice will be found extremely valuable in "stretching" the resources of our two basic ranks, particularly in balancing solo combinations against accompanimental registrations. The facility so afforded of being able to restore the original levels rapidly is one for which I have often wished in playing

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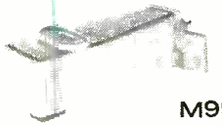
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 M7/N21D	A top-rated cartridge featuring the highly compliant N21D tubular stylus. Noted for its sweet, "singing" quality throughout the audible spectrum and especially its singular recreation of clean mid-range sounds (where most of the music really "happens".) Budget-priced, too.	For 2 to 2½ gram tracking. Especially fine if your present set-up sounds "muddy." At less than $20.00, it is truly an outstanding buy. (Also, if you own regular M7D, you can upgrade it for higher compliance and lighter tracking by installing an N21D stylus.)
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church services on a somewhat similar commercial electronic organ.

There are, as implied above, commercially available organs very similar to this specification in the $3000 to $4000 bracket. None with which I am familiar, however, embodies precisely this stoplist nor do any have the "Mute" tabs described above. Such an organ could be built from "scratch" or by using kits for about two thirds of this amount. Used consoles are not impossible to come by. If you can find one that is suitable, the cost can be further reduced. A great advantage of the individual oscillator scheme is that the organ is playable as soon as the first few octaves of one rank of generators are working. This is not true of divider organs. This means that one can begin to make at least some music before one's cash outlay is too great.

Table II

Second Stoplist

Manual I	Manual II	Solo (Floating)	Pedal
8' Principal	8' Principal	8' Open Diapason	16' Contrebasse
8' Flute	8' Flute	8' Clarinet	16' Bourdon
4' Principal	4' Principal	8' Trompette	16' Gedact
4' Flute	4' Flute	8' Tuba	8' Principal
2-2/3' Twelfth	2-2/3' Nazard	8' Concert Flute	8' Flute
2' Fifteenth	2' Fifteenth	Tremolo	4' Principal
1-1/3' Larigot	2' Piccolo		4' Flute
1' Sifflote	1' Sifflote		16' Bombarde

Couplers

Solo to I 16' (Tenor C)	Solo to II 16' (Tenor C)	Solo to Pedal 8'
Solo to I 8'	Solo to II 8'	Solo to Pedal 4'
Solo to I 4'	Solo to II 4'	

Voicing Controls (3)

Flute Mute (Stop Tab and Potentiometer)
Principal Mute (Stop Tab and Potentiometer)
Solo Mute (Stop Tab and Potentiometer)

Expression Pedals (2)

No. 1 Controls Flute, Principal and Pedal 16-ft. Ranks
No. 2 Controls Solo Rank

This stoplist is not without its shortcomings, however. Although sufficient mutation stops have been allotted to the two manuals to permit the synthesis of a variety of interesting colors, some pieces will be found in which they won't be wholly satisfactory. Those in which a solo part dips into the baritone or tenor range are a case in point. There's no good substitute for a solo reed in these. If one attempts to play some of the French literature (Vierne, Widor, *et al*) the need for chorus reeds will be apparent. Some pieces will persist in presenting problems of balance between solo and accompaniment despite the ubiquitous "Mute" tabs. One will also find that a greater variety of 16-ft. Pedal tone will be helpful. By adding two non-unit ranks we can correct most of these deficiencies. One rank may be a floating Solo rank of 73 oscillators associated with a tone-changing circuit. The other may be an independent Pedal 16-ft. rank. The latter will require only 20 new oscillators, as the bottom octave of the unit flute may now be deleted and transferred to this new use. The stoplist at the completion of this phase of construction might look like Table II.

All Pedal 16-ft. tone is derived from the Pedal 16-ft. rank. As this rank is used at only one pitch, several timbres may be derived from it. For use over the limited range of the Pedal clavier there is no objection to "formant" filters as the loudness and timbre uniformity problem is much less severe. The Gedact should be the softest Pedal stop. The Bourdon may be of the same timbre (i.e. come from the same filter) but should be louder. The Contrebasse is merely a somewhat "stringy" Principal. The Bombarde is a loud reed. Other voices may better suit other constructors and there is certainly no objection to their introduction.

The Solo division is "floating." In organ terms this simply means that no separate manual is provided for it but it may be coupled to any of the existing manuals. In this specification it is made playable on each manual at three pitches and on the Pedal at two. As an economy measure a 73-note rank has been specified. This means that the 16-ft. couplers will be ineffective in the bottom octave (below Tenor C). In the great majority of cases where 16-ft. manual tone is required this won't be found unduly restrictive. By all means put the extra 12 oscillators in if you want them.

The stops suggested for the Solo division have been chosen with a definite purpose in mind for each. The Open Diapason is intended as an additional voice to be added to the Primary Chorus. It might be voiced slightly louder than the unit Principal. The Clarinet is suggested as a colorful, mezzo-forte, general purpose solo reed. The Trompette is a bright chorus reed, loud, but not sufficiently so to engulf the Primary Chorus completely even when used at several pitches simultaneously. A single "formant" filter will be inadequate to cover the whole range of this stop. The Tuba is intended as a very loud reed, able to make itself heard over the whole organ for fortissimo solo effects. As a compromise it might just be the Trompette at a higher level, though a somewhat "weightier" tone would be preferable. The Concert Flute is envisaged as a mezzo-forte solo voice, preferably with a somewhat different timbre than the unit Flute.

We have now arrived at a total of four ranks comprising 275 oscillators. At $5.00 per oscillator, the tone generators alone will come to $1375. By the time one adds a console, power supplies, stop filters and a modest complement of power amplifiers and loudspeakers this amount will be about trebled. The organ, if carefully voiced, however, would surpass some commercial designs in the $8000 bracket and would give not a few pipe organs of appreciably higher cost a good run for the money.

Again, one can proceed gradually. Having built the organ to the stoplist of Table I, for example, one's next step might be to fit the Solo tone changer circuits to the original Principal rank temporarily while one was completing the next rank. This would make some of the solo voices playable against the Flute rank, although unless the nomenclature of all the Principal rank stop tabs was changed, most organists would have some initial difficulties in becoming accustomed to the organ.

As yet there is no Celeste stop. Such a stop requires two ranks, identical, or nearly so, in timbre and loudness. One is slightly detuned to produce slow beats when the two ranks are used together. There are two ways of adding this lovely romantic voice to the organ. The most obvious and best is to add another rank of oscillators. It may be a short rank of only 49 notes as most Celeste stops do not extend the out-of-tune rank downward below Tenor C. Alternately, provision could be made to detune one of the ranks already in the organ when a special stop tab was operated. An obvious way to do this is by connecting a 49-contact "switch" (relay) to shunt additional tuning capacitance across each oscillator to be affected. With some types of oscillators a similar result can be obtained by shifting the operating point (bias).

If one were to add the luxury of a separate rank of oscillators, connecting it to a rudimentary tone changer so that either Flute or Principal tone could be obtained, two different types of Celeste stops would be feasible, Flute Celeste and Viola or Dulciana Celeste. A Dulciana resembles a very soft Principal. I would suggest a Flute Celeste on Manual I and a Dulciana Celeste on Manual II. These stop tabs will require somewhat more complex switching than the others.

(Continued on page 85)

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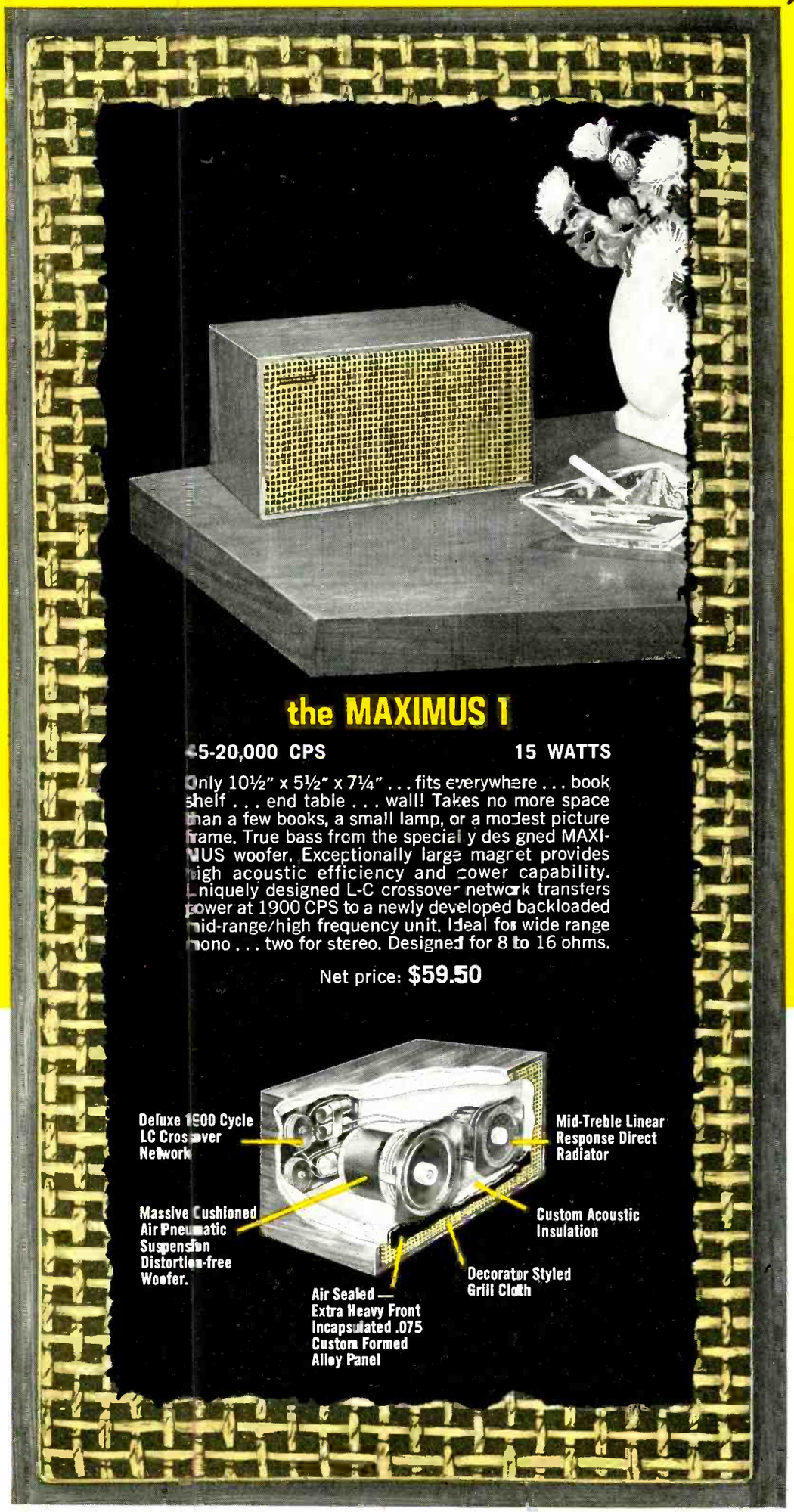
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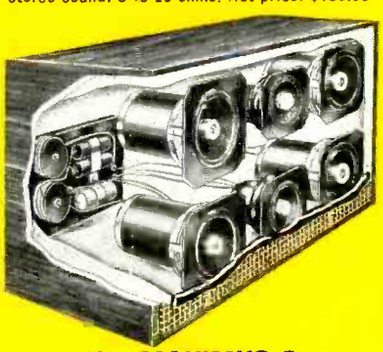
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An Engineer Looks at Exponential Horns

W. A. DODGE*

An engineer explains to the novice the proper technique for designing exponential horn enclosures without the necessity on his part of understanding a great deal of acoustical theory.

MUCH HAS BEEN WRITTEN in the pages of this magazine and elsewhere about the advantages of horn enclosures over any other type of baffle. Unfortunately, when it comes to designing a horn to reproduce bass properly the basic principles involved seem to be quite vague to all but a handful of experts. Consequently, enclosures have been designed and built which are either ridiculously small, are tapered too gradually, are too short, or a multitude of other sins. A knowledge of the basic horn equation and an arbitrary selection of a low cutoff frequency simply isn't enough. The unfortunate results too often are that, while ecstatic designers report befuddling their friends and confounding their enemies with unholy amounts of bass, the neighbors still go right out and buy bookshelf boxes just the same. Horns have, in general, not enjoyed a good reputation as bass reproducers.

The author ran across such an enclosure once; a rear-loaded thing manufactured by a British firm of otherwise good reputation. Not a great deal bigger than a large bookshelf speaker, it failed to produce any noticeable bass even with one's head in the flare. Otherwise, it was a satisfactory design. The trouble here, just as you might suppose, is that to reproduce bass efficiently the horn must be big and long. To put it another way, any horn properly designed must have a length and mouth opening a sizable fraction of the cutoff wavelength. If this rule is violated than you only think you have a horn. Whether efficiency with the added inconvenience of largeness is a disadvantage will have to be answered by each builder individually, but it helps to have an oversize living room.

Now, exactly what is a horn? In enclosure design it refers to some kind of flaring device connected to a loudspeaker. It usually is quite small at the beginning and get progressively larger. Horns have been the subject of a considerable amount of mathematical analysis, therefore it isn't surprising that they should be classified accordingly. Depending on how the cross-sectional area changes with distance they can be conical, parabolic, hyperbolic, or exponential. However, there can be vast differences in how these perform. Exponential is the type most often selected for music reproduction. Nobody uses parabolic horns for anything as far as I know, conical horns turn up most often at football games as megaphones and hyperbolic flares are used for foghorns. By balancing out uniformity of response over a given frequency range *versus* the size of the enclosure needed, the exponential flare is probably the best choice. In any event, it is the most analyzed and easiest to work with of all the types mentioned.

A simple exponential horn speaker system is shown in *Fig.* 1. All the necessary ingredients for building one are listed. Simply choose a value for S_t and cutoff frequency f_c and S is determined by X. However, for a predetermined level of performance choosing *exactly* what S_t, *exactly* what m and *exactly* what X_{max} should be used makes the design a little harder. Also, it is assumed that the horn should be no larger than absolutely necessary.

For a start, let us consider the efficiency calculation. For a horn operated somewhat above cutoff, the equivalent circuit[1] of *Fig.* 2 can be used.

This equivalent circuit assumes negligible resistive loss in the speaker suspension (a high Q) and no loss behind the speaker (C_{mb} is a perfect capacitor). For low frequencies this latter assumption is valid unless, of course, the chamber should be filled with Fiberglas or some such material.

Now, efficiency can be defined in many ways; I prefer the fundamental ratio of $\frac{\text{Power Output}}{\text{Power Input}} \times 100\%$. From the equivalent circuit, using the above definition, we get, after some manipulation,

$$\text{Efficiency} = \frac{R_L}{R_e + R_L} \times 100\% \quad \text{Eq. (1)}$$

where R_L is a function of speaker parameters and is defined in *Fig.* 2. However, for the amplifier to deliver maximum power, it must "see" the proper terminating impedance. That is, the load presented to it must be one of the ones it was designed for (8, 16, 32, and so forth in ohms). This means that $R_e + R_L$ should equal one of these values. Since one has considerable control over the value of R_L by properly choosing a value for "a", than the sum $R_e + R_L$ can be made to equal the correct amplifier load. If a 32-ohm speaker were used, then a conservative approach would be to choose $R_e + R_L$ to equal 32 ohms and connect the speaker system to that tap on the amplifier. This choice immediately defines R_L, the efficiency, and enables us to determine S_t, the beginning dimension of the horn, all in one fell swoop as it were. Please note that the efficiency resulting from choosing R_L in this manner will not necessarily result in a "maximum" efficiency but is usually sufficiently high.

* *Aerospace Division, Westinghouse Defense and Space Center, Pittsburgh, Pa.*

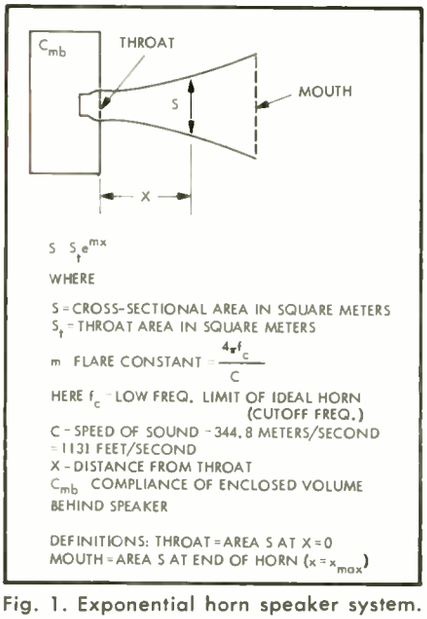


Fig. 1. Exponential horn speaker system.

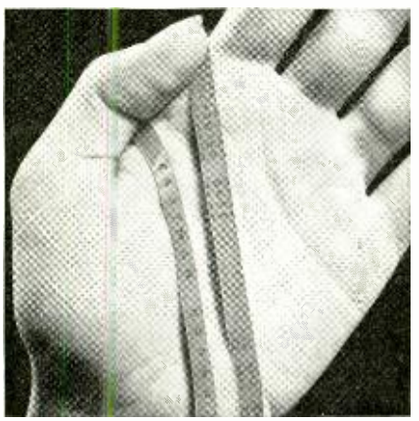
[1] Leo J. Beranek, *Acoustics*, McGraw-Hill, p. 262.

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Some plain talk from Kodak about tape:

features and conveniences that result in better use characteristics

It's amazing what good things can happen when you've got a hobby. A lot of our scientists working on KODAK Sound Recording Tape have hobbies. And in almost every case, coincidentally, the hobby is tape recording. And engineers being the sort of restless, dissatisfied people they are, all kinds of off-hours research projects are in work to give Kodak tape a few extra features in terms of handling ease. One of our boys, for example, decided that he wanted to know just what kind of tape he was using in terms of thickness and base type, even when it was separated from its box. And he



wanted to know it at a glance. Another engineer decided that nothing would be more valuable from a quality-control standpoint than a method of knowing just when a given roll of tape was made. And even what part of the master web it came from. This led to a virtual revolution in the tape business. In an age when more and more companies are taking their names off their products and furtively selling them in unmarked white boxes, we are so proud of the quality and uniformity of our product that we are putting our name right on the back of the tape itself.

And not just our name. The kind of tape, too. Won't it be nice to know that you are using half-mil-polyester-triple-play every time you are using half-mil-polyester-triple-play? This means that even when you are using Kodak tape on an unmarked reel, you can still identify it. And you'll also know whether or not the reel has been rewound simply by looking at the imprint and noting how it reads as the tape comes off the reel.

Familiar with our Thread-Easy Reel? It's really worth knowing about because it cuts fumbling time down to zero. Here's how: you just take the end of the tape and drop it into the slot in the reel. Half a turn and it's engaged . . . securely. That's all there is to it. Not a worry about manhandling your tape, either. This reel's a real gentleman! Smooth surfaces. Bevelled edges. Dynamic balance. And notice, too, that each Thread-Easy Reel has a built-in splicing jig. That, plus the fact that it is calibrated on both sides, adds a few extra fillips well worth having. If you have been really keen-eyed, you have probably noticed by now that we have been referring to Kodak tape where in previous ads we have always called it Eastman tape. There's a good reason for that. We've changed the name. Goodbye good old Eastman tape. Hello good old Kodak tape. This brings up a small problem. With the name change there are also number changes. And so you'll know just what to ask for, here's how the nomenclature looks (old Eastman tape numbers are in parentheses):

KODAK TAPE	BACKPRINTING CODE		
Type 31A (Type A303)	DUROL BASE	1½ Mil	Std Play
Type 34A (Type A304)	DUROL BASE	1½ Mil	Hi Output
Type 21A (Type A203)	DUROL BASE	1 Mil	Extra Play
Type 21P (Type P203)	POLYESTER BASE	1 Mil	Extra Play
Type 11P (Type P103)	POLYESTER BASE	½ Mil	Double Play
Type 12P (Type P105)	POLYESTER BASE	½ Mil	Triple Play

Note that the above list contains a pretty broad spectrum of recording tapes on both Durol base (indicated by an "A" in the above chart) and polyester ("P"). That's another nice thing about the Kodak line. You can get just about anything you need.



KODAK Sound Recording Tapes are available at all normal tape outlets—electronic supply stores, camera stores, specialty shops . . . everywhere. Oh, by the way, why did we change the name from "Eastman" to "Kodak"? Don't know, just thought it was a good idea at the time.

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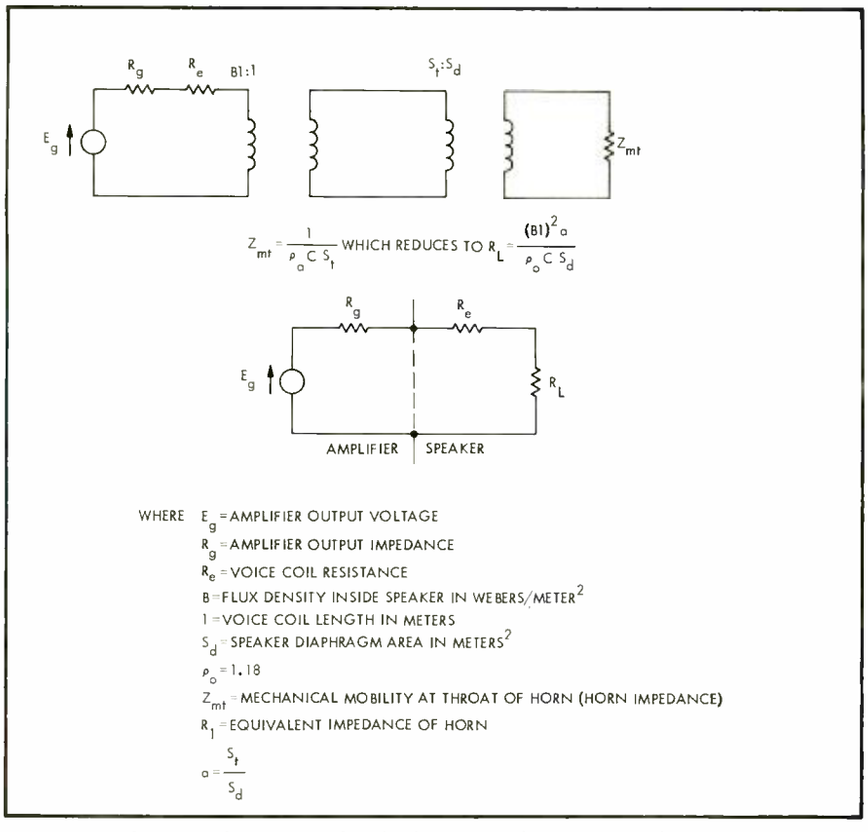


Fig. 2. Equivalent circuit for the horn, speaker, and amplifier system.

To see how this process can be carried out, I have chosen for an example a rather efficient woofer, the Lansing 150-4, a 32-ohm speaker. Its measured voice coil resistance, R_e, is 18 ohms, therefore $R_L = 32 - 18 = 14$ ohms and efficiency = $\frac{14}{32} = 43.7\%$. Bl is given as 45.6 webers/meter and $(Bl)^2 = 2079.4$. S_d is measured as 0.079 meters,[2] therefore

$$R_L = \frac{(Bl)^2 a}{\rho_o C S_d} = \frac{(2079.4)\ a}{(1.18)\ (344.8)\ (.079)}$$

$$= 14 \text{ or } a = 0.218 \qquad \text{Eq. } (2)$$

$$\text{Since } a = \frac{S_t}{S_d} = \frac{S_t}{.079}$$

$$= 0.218,\ S_t = 0.0173 \text{ meters}^2$$

The value for "a" is thus seen to depend on the speaker chosen and will be different for every case. To aid the designer I will outline a simple method for determining the Bl product in case he can not obtain it from the manufacturer.

There is a relationship

$$F = (Bl)\ i \qquad \text{Eq. } (3)$$

where F = force in Newtons (Newtons (0.102) = Kilograms
i = current through the voice coil in amperes

Refer to *Fig.* 3. Place the speaker cone upward on a table, connect it to a d.c. power supply and monitor the current. Lay a ruler across the rim of the basket and drop a light rod straight down so that it stands on the cone and rests against the ruler. Mark the point of contact and then lay a heavy calibrated weight (200 grams or so) on the cone. The speaker will drop so bring it back up to the marking on the rod with the current control. The force F is exactly equal to the weight, and since the current is known Bl is determined.

The next step, and one of the most important, is the determination of the proper horn size. Remember, we know its beginning dimension, S_t, but not the length X_{max} or the mouth opening. To do this properly we should remember that in *Fig.* 2 a value for z_{mt}, the horn impedance, was given and that it was treated as a resistance. Actually, this is not quite true. It is composed of a resistive and a reactive part which have ripples that increase with decreasing frequency. To make the diameter of the mouth opening smaller than 0.15 λ_c would make the magnitude of the ripples increase and the sound output vary by more than 3 db. Making the horn length shorter than 0.25 λ_c spreads the peaks apart and away from f_c. Useful response being somewhat above cutoff anyway and a horn that is too short just makes this situation worse.

To show clearly the effect of these ripples I have included them graphically in (A) of *Fig.* 4, and the impedance of an infinite horn in (B) of *Fig.* 4.[2] For purposes of comparison both of these are normalized to unity and are a plot of the impedance a horn presents at its throat. The sound output also varies in much the same way. It would appear that little would be gained by making the horn shorter than that indicated in (A) of *Fig.* 4 since efficient response would stop further above cutoff. To compensate, the cutoff frequency would have to be moved further down, thereby making the horn bigger again since λ_c increases.

3-db peaks in the response may not sound like much and the designer may be happy to settle for 6 db, or even 12 db if the horn can be made smaller. For instance, this means that the mouth diameter can be smaller than 0.15 λ_c. However, this decision also tends to move the beginning of maximum efficiency further up and necessitates choosing a proportionally lower cutoff frequency. There is *some* tradeoff possible between horn size and response peaks, or horn size and the number of speakers used (throat diameter), but using the dimensions outlined in *Fig.* 4 (A) will result in a good conversative design. On the other hand, if every consideration given above were violated and a horn was built that was really short and sweet, then you would find that the cutoff frequency could be chosen somewhat above the lowest frequency of interest. This is because any

[2] Olson, *Elements of Acoustical Engineering*, Nostrand, pp. 107 & 109.

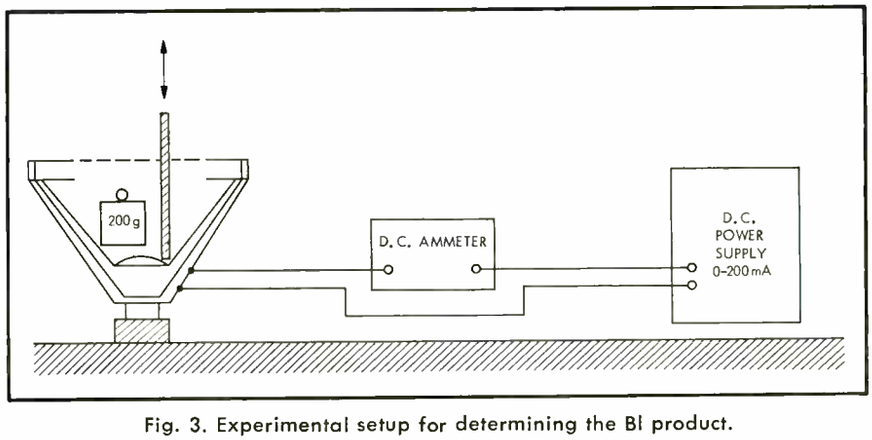


Fig. 3. Experimental setup for determining the Bl product.

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finite horn still has *some* output, even below cutoff, and a really small horn is so inefficient for an octave or two above cutoff that there really isn't much change in going below cutoff. In this case the cutoff frequency f_c doesn't have much practical significance.

The proper choice of a value for f_c should be of some concern since this will obviously affect the size of the horn. Some people feel that this should be as low as possible in case one should have earthquake records to reproduce. However, since most would wish the enclosure to be no larger than absolutely necessary earthquakes will have to be forgotten and f_c chosen as high as possible. It is reported that often discs are recorded with no frequencies below about 70 cps (organs excepted).[3] Also, it has been shown for orchestral music that eliminating frequencies below 60 cps is scarcely noticeable, even under critical conditions.[4] Therefore, f_c could be chosen as high as 70 cps, if desired, for good performance. However, sometimes lower frequencies will emerge on discs and a lower cutoff frequency would be nice. Low *C* on the piano is 32.7 cps and there is little point in reproducing frequencies below this. Therefore, f_c need be chosen no lower than that required to reproduce this frequency properly.

Using this as our criterion, suppose we now get out horn down to a matter of feet and inches. If f_c is chosen as 30 cps, than from *Fig.* 4(A) response will begin about 10 per cent higher, or 33 cps. Also, $\lambda_c = 37.7$ ft. and the horn length X_{max} becomes 9.4 ft., the mouth area 25 sq. ft. and the throat area 0.94 sq. ft. Using this as a guide we can proceed with laying out the horn. For the JBL speaker used in the previous example, the throat area S_t was calculated as 0.0173 square meters = 0.186 sq. ft. If we were to use four of these speakers the necessary throat area would become 0.744 sq. ft. This is close to the desired 0.94 sq. ft. Now, Taking the horn equation

$$S = S_t e^{MX} \qquad \text{Eq.(4)}$$

where $S_t = 0.744$ ft.^{2} (0.069 meters^2)

and $m = \frac{4\pi 30}{1131}$ ft./sec = 0.332

$(m = \frac{4\pi 30}{344.8}$ meters/sec = 1.09)

at last, a table of dimensions can be drawn up. At $x = 0$, $S = S_t = 0.744$ sq. ft., of course. Taking $x = 10.5$ ft., S = 24.2 sq. ft. which is almost the desired mouth opening. However, since for this mouth opening the horn length came out longer than that desired (10.5 ft. vs. 9.4 ft.), X_{max} can be chosen slightly less than 10.5 ft. All points between can now be calculated as well.

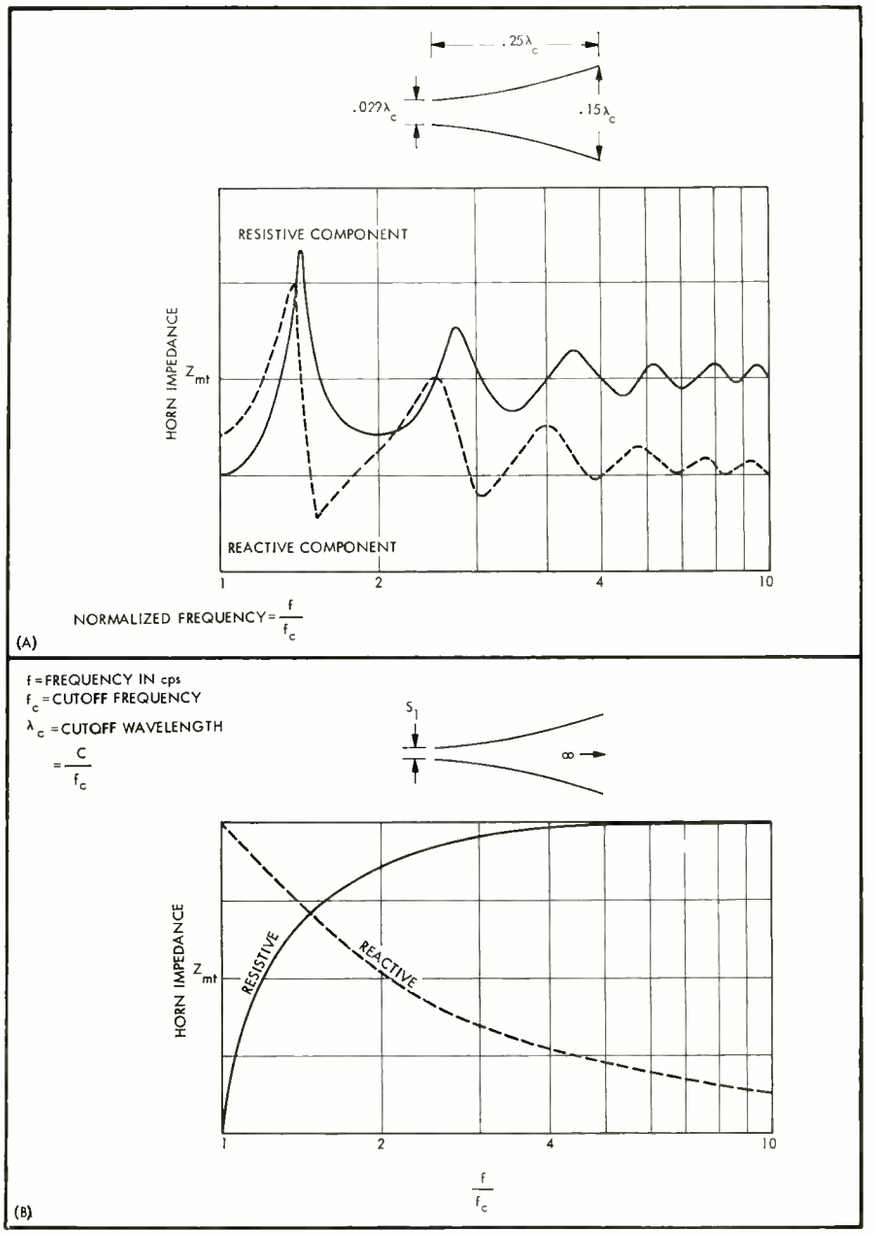


Fig. 4. Horn impedance as a function of frequency and size.

We are still not quite through with our design, however. One thing that it is always necessary to determine is the size of the air chamber enclosing the rear of the speakers. This chamber acts like a spring or capacitor in series with the speaker and was shown in *Fig.* 1 as C_{mb}. The net effect is to raise the resonant frequency of the speaker by some predetermined amount, and this is very good and helpful as we shall see. In *Fig.* 4(B), showing horn impedances, the reactive component increases with lowering frequency as the resistive component goes to zero. Well, it turns out that this reactance actually looks like a *negative* capacitance, and it is possible to cancel this out with the real *positive* capacitance presented by C_{mb}. The effect of this maneuver is to extend the bass response slightly by causing only a resistive load to be seen by the speaker. A front-loaded corner horn is a system designed in this manner, and this is the reason why they usually sound bassier than other types of horns. To calculate the volume of this air-chamber isn't in itself difficult, but it is complicated by having the speaker in series with it.

First of all, the value of the negative capacitance we have to cancel we can call C_{mt}, and

$$C_{mt} = \frac{2S_t}{S_d^2\, \rho o\, C^2\, m} \text{ meters/newton}$$

All the quantities appearing in this

(*Continued on page 85*)

[3] J. G. McKnight, The Case Against Low-Frequency Pre-Emphasis in Magnetic Recording, *Journal AES*, April, 1962, p. 107.

[4] W. B. Snow, *Journal Acoustical Society of America*, 1931, pp. 155–166.

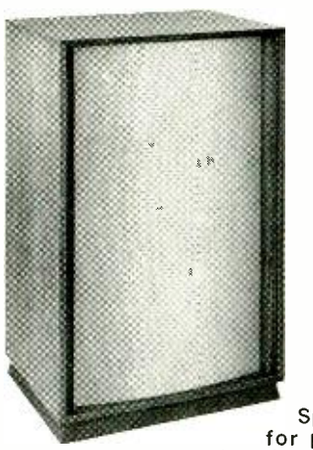
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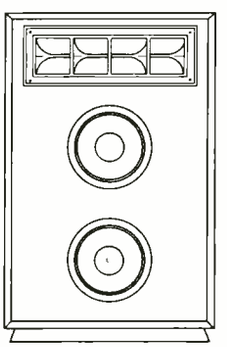


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FOR THIS MUCH MUSIC

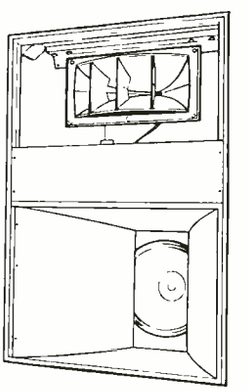
with Altec PLAYBACK Home Music Systems





ALTEC 843A "MALIBU" contains the same speaker components as the new 844A Monitor & PLAYBACK Speaker System (shown at right) for professional recording and broadcast studios: a pair of low resonance Altec 414A bass speakers, a cast aluminum sectoral horn powered by an Altec 804A high frequency driver, and a two-section dividing network. Dimensions: 40"H, 25"W, 18"D. Price: $356.00 in Walnut. Low-boy model—the 838A "Carmel"—is also available.





"VOICE OF THE THEATRE"® Speaker Systems now come fully clothed, ready for your home or high quality applications in public places where both styling and excellent sound are the goal. Available as the A7W or A7-500W models, these are the identical PLAYBACK speakers used by leading recording studios. Dimensions: 46" H, 30" W, 24" D. Price: A7W Speaker System, Walnut Finish—$384.00; A7-500W Speaker System, Walnut Finish—$411.00.

NOTE for do-it-yourself decorators and recording engineers: The A7 and A7-500 are available as usual in their economical utility cabinets at $288.00 and $315.00 respectively.

ENJOY SOUND WITHOUT COMPROMISE WITH THESE NEW FULL-SIZE PLAYBACK SPEAKER SYSTEMS FROM ALTEC:

These new Altec PLAYBACK speaker systems contain all of the elements that are essential to give you *no-compromise big sound*. Each is large enough to hold a low-cutoff sectoral horn which permits the simplicity of a two-way system with a single crossover. Use of a 90° horn provides perfectly controlled, wide angle dispersion of both the *mid and high frequencies* to achieve *big sound*. This subject of "big sound" is fully covered by both proponents in THE GREAT DEBATE, mentioned elsewhere in this advertisement.

Both the 843A "Malibu" and the "Voice of the Theatre" Systems are full-size, floor-standing PLAYBACK units with impressive cabinets in walnut. They are styled to do credit as an impressive furniture piece in any living room. In fact, these are loudspeakers that you can display proudly... and listen to by the hour.

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NEW FULL-SIZE PLAYBACK® SPEAKERS FROM ALTEC NEED ABOUT 3 SQ. FT. OF FLOOR SPACE TO GIVE YOU NO-DISTORTION MID-RANGE WITH LOWS & HIGHS TO MATCH

THE ALL-IMPORTANT MID-RANGE

Almost any good speaker has good lows and highs because so much attention has been given to these extremes of the frequency spectrum in recent designs. *But very few speakers have really good mid-frequencies.* Yet, it is the mid-range that holds the primary attention of the recording engineer because *this region embraces 90% of all musical material.* Most fundamentals and all of the rich lower harmonics are in this critical range. It is the meaty part of music and is essential for life-like reproduction.

When you judge one of the new Altec PLAYBACK speaker systems through A-B comparison listening tests, we urge you to especially notice their clean, no-distortion mid-range. Their smooth, no-distortion reproduction in this region makes a subtle, though readily discernible, difference – a difference that explains why so many major recording studios depend on Altec PLAYBACK speakers for monitoring and playback in a continual comparison of the live rendition to the freshly recorded version.

While listening, ask to hear a full orchestration of many pieces performing through a wide dynamic range. *This is the acid test for good mid-range.* It will quickly expose what is known as "mid-range muddiness"—a distortion which has crept into many speakers of recent design due to the attention concentrated on highs and lows, with little or no regard for the mid-range.

THE GREAT DEBATE ABOUT BIG VS. LITTLE SPEAKERS

As was inevitable, the controversy about big vs. little speakers had to be settled sooner or later. Now, the tiresome argument is over, with expert proponents stating the case for each side. We're of course referring to "THE GREAT DEBATE" which appeared in the August issue of *HiFi/Stereo Review,* titled "IS A GOOD BIG SPEAKER BETTER THAN A GOOD LITTLE SPEAKER?". If you haven't yet read it, just let us know and we'll gladly send you this reprint giving both sides.



Not surprisingly, we were asked to speak up for the affirmative—that a good big speaker is indeed *much* better than the best little speaker. We are certain that if you want the best there is in musical reproduction you will give up some floor space for our good full-size speaker systems. Write Dept. A11.

ALTEC LANSING CORPORATION
LTV A Subsidiary of Ling-Temco-Vought, Inc.
ANAHEIM, CALIFORNIA



604 "DUPLEX"® IS BACK! The most famous single speaker in history of high fidelity is back, packed with all the new engineering knowledge that has been acquired since its original design two decades ago. The new SUPER "Duplex" 604E is an updated version of the original and famed 604A, B, C, and D Models (you'll find more of these speakers still in use in quality recording and broadcast PLAYBACK and monitoring than any other speaker ever made).

The SUPER "Duplex" offers highest efficiency like all Altec speaker systems with full capability of reproducing the entire dynamic range of music with today's medium-power transistor amplifiers. Also check the 604E for purity of mid-range, exceptional attack time, and no-distortion 20-22,000 cycle frequency range. With a dual magnetic structure that *weighs 26 pounds, 13 ounces,* the SUPER "Duplex" 604E is the most efficient speaker offered to the home music market. Price: $199.00 including two-section dividing network.

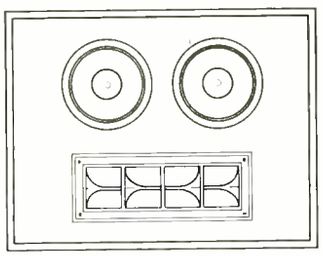
For optimum performance, we recommend the "Malibu" furniture-styled enclosure for the SUPER "Duplex". It is available as the 855A Cabinet and comes with pre-cut baffle for easy installation. The 855A is priced at $126.00 and is also recommended for use with any other 15" Altec speaker.

TAKE A CUE FROM THE RECORDING & BROADCAST STUDIOS: SELECT A NO-COMPROMISE SPEAKER SYSTEM

Professionals in sound – people whose careers as performers, directors, and recording engineers depend on the quality of their equipment – have for years relied on Altec PLAYBACK equipment in their studios. In fact, in the days before the term "hi fi" was ever coined, Altec was already producing studio-quality PLAYBACK components. And, as another fact, high fidelity as we know it today was born right in those same recording, broadcast, and motion picture studios.

You can bet your bottom dollar that the studio professional not only expects, but knows where to get sound quality that approaches the "live"...and no compromises tolerated. Perhaps that's why so much of our income comes from the professional and commercial sound industries. Here's an example of our latest design for the professional market:





NEW! SPECIFICALLY FOR RECORDING & BROADCAST USE: STUDIO VERSION OF THE "MALIBU" & "CARMEL" • Designed especially for recording and broadcast studios, the 844A Monitor & PLAYBACK Speaker System contains the same speaker components are the 843A "Malibu" and 838A "Carmel". Comes in studio grey cabinet with sectoral horn mounted below the low frequency speakers so that the unit may be mounted above the observation window in studio control rooms. Dimensions: 24" H, 31" W, 16" D. Price: $327.00.

Circle 121 on Reader Service Card

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NEW PRODUCTS

● **Condenser Microphone.** Syncron Corporation of Wallingford, Connecticut has introduced the AU7a, a new concept in condenser microphone design. The latest in solid state devices coupled with advanced battery development has brought about a truly self contained condenser microphone. An operating life of over 2500 hours is achieved through the utilization of new low drain



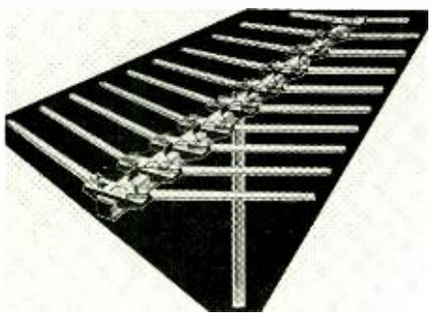
cells. Frequency range of 30–18000 cps; cardioid pattern; low-noise single-transistor amplifier with a switchable balanced output of 50 or 200 ohms. Rugged epoxy finish of tan and satin chrome, it is furnished in an attractive walnut case, complete with batteries and 25 feet of cable for $169.50 SYNCRON CORPORATION. 10 George Street, Wallingford, Connecticut. **Circle 200**

● **Stripper and Cutter.** Audiophonics Corporation has made available the new Strip-It wire and cable stripper. (Patent Pending). Designed for the electronic industry, Strip-it is a ruggedly built tool which is easy to use. Small enough to fit the palm of the hand, it can be used in all



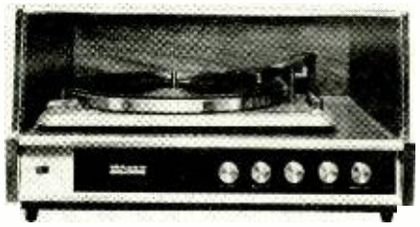
sorts of tight spots. Strip-it adjusts instantly to any wire size. Strip-it can also be used to cut wire. Replacement blades are available and are easily installed. Audiophonics Corporation, 95 Rantoul Street, Beverly, Mass. **Circle 201**

● **VHF-FM Antenna Line.** The Finney Company has launched their new Swept Element "COLOR-VE-LOG" antennas. The swept element design of the new FINCO line is claimed to give brilliant color reception, sharply defined black and white, and superb FM monophonic and stereo



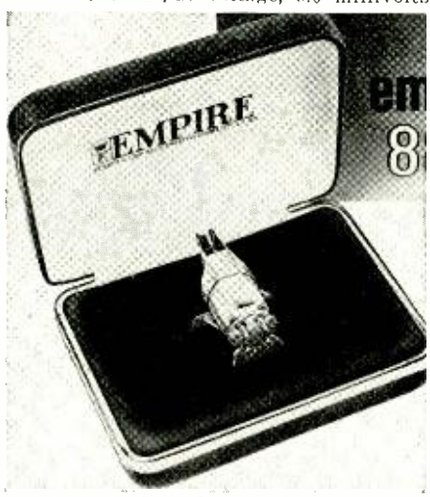
quality. Several unique features are incorporated in the construction of these antennas to make them virtually trouble-free and weather-proof. All carry an unconditional FINCO guarantee. **Circle 202**

● **Stereo Amplifier.** Benjamin Electronics has developed a 36-watt stereo amplifier measuring 2″ × 8″ which can be fitted under the Miracord 10 automatic turntable. Specifications are 18 watts per channel



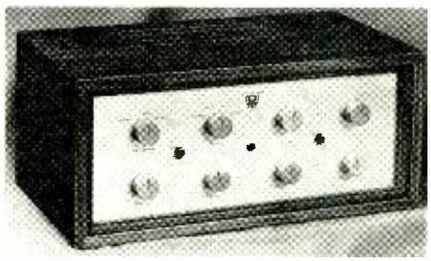
IHF; distortion less than 0.5 per cent at rated output; frequency response 10 cps to 22kc ± 1 db; 30 cps to 12 kc power bandwidth at 1 per cent distortion; separate bass, treble, volume and balance controls, mode selector; auxiliary inputs for tuner or tape; tape output jacks. The Stereo 200 will drive any pair of quality speakers with medium to high efficiency, though the matched Benjamin 208s are recommended for optimum performance. Benjamin Stereo 200 price $229.50 includes stereo-magnetic diamond cartridge and oil-rubbed walnut enclosure with lucite lift cover. Benjamin 208 speakers are extra, $49.50 each. Stereo 200 cabinet measures only 18½ × 16 × 9½″, no larger than would be required for the Miracord alone. **Circle 203**

● **Empire Elliptical Stylus.** Empire Scientific Corporation recently began distribution of its new 880PE elliptical stylus cartridge and elliptical stylus replacement. The new 880PE carries all the standard features of the 880P plus some new ones. Specifications are: Frequency range, 8 to 30,000 cps; output voltage, 8.0 millivolts



per channel; channel separation, more than 30 db; load impedance, 47,000 ohms; weight, 10 grams; compliance, 20 x 10-6 cm/dyne; tracking force, ½ to 4 grams; stylus, 0.2 x 0.9-mil bi-radial elliptical hand-polished diamond; 4-terminal output; standard 7/16- or ½-inch mounting centers; 15-deg. vertical tracking angle. Retails for $29.95 **Circle 204**

● **Integrated Control-Amplifier.** Whitecrest Industries has designed a new stereo integrated control-amplifier priced at $149.95. The Whitecrest APS-100 incorporates features for home music reproduction and is guaranteed for both parts and labor for two years. Available in a grained oil walnut cabinet at $19.95. Large output transformers with grain-oriented laminations. Six silicon rectifiers and ample power transformer for excellent regulation. Stereo music power output (IHF, both channels) 60 watts. Each channel has individual bass and treble controls. Loudness contour control. Additional specifications are: Power output (rms, per channel) 27.5 watts, harmonic distortion (at rated output) 0.25 per cent intermodulation distortion (at rated output) 0.75 per cent; hum and noise level 80 db below rated output; frequency response, 10–20,000 cps ± 1 db; sensitivity (for rated output) 300 mv (high



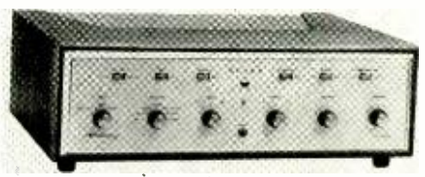
level inputs), 3.5 mv (phono input), 2 mv (tape input); output impedances, 4-8-16 ohms; tube complement: (4)-7591, (4)-12AX7, (2)-12AU7, (6)-silicon diode rectifiers; bass and treble control range – 15 to + 15 db; power requirements, 117 volts 60 cps; chassis dimensions: 5¾″ H, 15″ W, 9½″ D. **Circle 205**

● **Squarewave Generator.** The ME-109 Squaremaker develops a high quality squarewave when operated in conjunction with an audio oscillator. Neither batteries nor power connections are required as the transistors derive their collector voltage



directly from the input sinewave. Frequency and amplitude are adjustable over a wide range by the oscillator controls. Typical performance data: 50 ns rise time; up to 35 volts output; useful as a trigger from 1 cps to 1 mcs; squarewave frequency range of 15 to 500 kc. Price is $15.95. Monterey Electronic Products. **Circle 206**

● **Complete Stereo Amplifier.** H. H. Scott, Inc. has announced the introduction of their new Model 233 66-watt stereo amplifier. The 233 retails for less than $190. Outstanding features of the 233 include: new decorator styling, speaker switch and front panel headphone outlet for private listening with the speakers silenced, a powered center channel output for an extension or center channel speaker without any additional amplifiers, and heavy duty output transformers for superb bass response even with inefficient speaker sys-



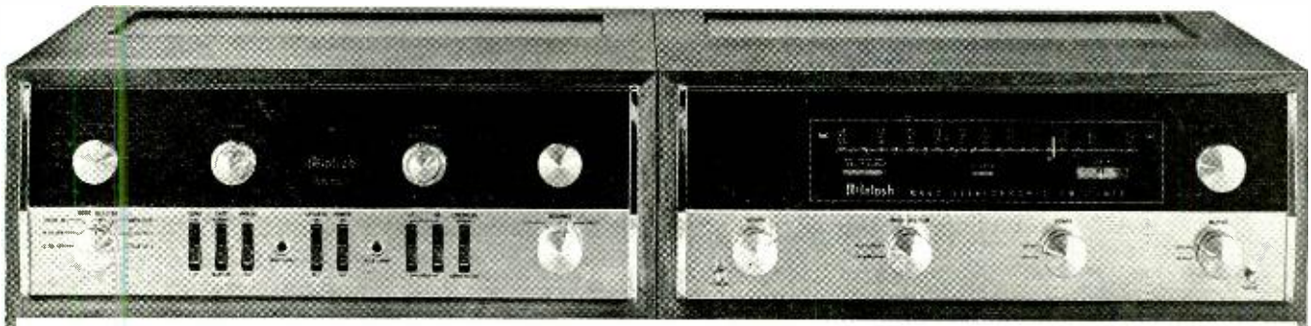
tems. Additional features of the Scott 233 stereo amplifier are: non-magnetic electrolytic aluminum chassis for efficient cooling and reduction of hum to inaudible levels, separate tone controls for each channel, dc. on preamp tubes for lowest hum, and Scott's patented balancing system to assure equal level from both speakers. H. H. Scott, Inc. **Circle 207**

(Continued on page 78)

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WANT PERFORMANCE, RELIABILITY and SATISFACTION?

YOU WANT McINTOSH. HERE'S WHAT THE CRITICS SAY ABOUT McINTOSH...



MA 230

AMERICAN RECORD GUIDE ON THE McINTOSH MA 230 COMBINATION PREAMPLIFIER/POWER AMPLIFIER

PERFORMANCE *". . . this integrated component is easily the equal of ANY combination of vacuum tube separate components. . . . I do not know another integrated amplifier with such superb power response."*

RELIABILITY *"Parts, all of premium quality, are beautifully laid out. . . . alone among the integrated designs using tubes known to me it does NOT tend to become a radiant room heater."*

SATISFACTION *"If this has begun to sound like a love song, this is because it is."*

The McIntosh MA 230 has a solid state preamplifier and dual 30 watt per channel tubed power amplifier. It has more real power, and longer reliability this way. The MA 230 gives you performance

MR 67

thought possible only with separate components a few years ago.

WHEN IT COMES TO FM STEREO TUNERS HERE'S WHAT AUDIO MAGAZINE HAD TO SAY ABOUT THE MR 67

PERFORMANCE *". . . is unexcelled by any other tuner . . ."*

RELIABILITY *" . . . the unusually high quality of components and construction practice; unquestionably . . . of paramount importance in making the intelligent engineering of the circuit available to the user for a long, long time."*

SATISFACTION *". . . the sound it produces is excellent . . ." ". . . the MR 67 is superb."*

The MR 67 is priced less than several competitive tuners. It has a built in multipath indicator. It has a nuvistor front end. Why settle for less?

PERFORMANCE IS GUARANTEED Your money back if your McIntosh unit does not meet its published specifications. Only McIntosh offers this money back guarantee.

RELIABILITY IS GUARANTEED You get a three year factory service contract when you own a McIntosh. Only tubes, fuses, and transportation are excepted.

SATISFACTION PROVEN OVER 15 YRS. Check the want ads. You hardly ever see a used McIntosh for sale. Why? McIntosh owners stay satisfied year after year.

EASY TO OWN Most dealers offer the MA 230 and the MR 67 together for as little as $65.00 down and less than $22.00 per month. Your old equipment will likely cover the down payment.

McIntosh LABORATORY INC.

6 CHAMBERS ST., BINGHAMTON, N. Y.

FREE copy of the above test reports available — send today.

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Send me reports on MA 230 and MR 67

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Good-bye thread-up problems!



FREE long-roll bonus! A self-threading reel with purchase of 7" roll of double or triple length tape!

No more tape fumbles, even with boxing gloves on! Just lay tape inside this reel, start recorder—and watch the reel thread-up automatically. Takes any tape thickness or leader tape. Releases freely on rewind. Get one free in the special pack shown. Just purchase a regular 7" reel of either double or triple length "SCOTCH" Brand Recording Tape (up to 6 hours recording time at 3¾ ips). See your dealer.

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Hello new mailing ease!



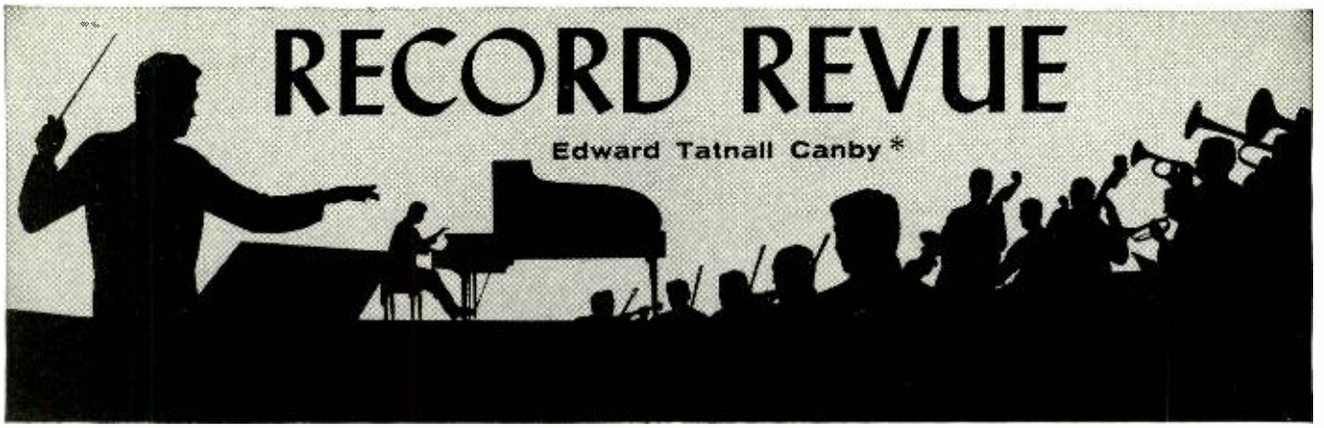
FREE short-roll bonus! New heavy-duty plastic mailer with each "Living Letter" tape!

New high-strength dust-free case for "Living Letters" makes handling, storage, mailing of taped correspondence the easiest, most secure ever. Conforms to new postal regulations. Address label included. Built-in post holds reel securely. *And the reel is new, too*—fits all reel-to-reel recorders. Only 3" reel available that holds full 600' of triple length tape (an hour recording time at 3¾ ips). 150' and 300' lengths also offered. Look for the new "mailbox" display at your dealer.

Magnetic Products Division 3M COMPANY

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RECORD REVUE

Edward Tatnall Canby*

The Sounds of Steelmaking. Produced by Harmon Associates, Inc. for U.S. Steel.

(Promotional stereo LP)

A good many commercial outfits are now going in for promotional documentary records in stereo. Some of them are inept, to put it mildly. Not this one! Considering the incredible noisiness of its subject, it is a model of professional persuasion, super-hi-fi and enjoyable too.

Noise yes, and plenty. Does anything make more noise than a steel mill? Phew! But that is just what is interesting here—for sheer noise on records is meaningless and confusing and the more you have on hand, the bigger the problem to make sense out of it. As these people know, a documentary recording must be a work of art, that is, a work of organized sense and continuity for the ear. They went at it the right way.

Excellent narration, to tie the many scenes together, roughing out the sequence of events as steel is made and distributed into its many forms. Fine timing of the sound, with plenty of variety, excellent rhythm effects, a minimum of confusion in all the din. Very considerable editing has gone into the job, too, boiling down what must have been unendurable miles of taped noise into a decidedly bearable sequence, artfully worked up. Fine job!

Stereo is used to maximum advantage, not only for a huge space-perspective in the enormous mills but to alternate and differentiate the sounds, from side to side. Some of it is perhaps even "faked" for extra effect, like the lovely sequence of nail-making machines banging away at different tempi, first on one side, then the other. Almost surrealistic but very convincing and most dramatic. An excellent technical job from beginning to end, this record, in all respects of its presentation.

CLASSICS

Richard Strauss Songs. Lisa Della Casa. Arpad Sandor, pf.

RCA Victor LSC 2749 stereo

Lisa Della Casa is one of the few great Strauss sopranos (he was particularly fond of the high soprano voice), who has had as a rival only Elizabeth Schwarzkopf, a finer musician if not a finer voice. Both produce that peculiarly lovely soprano eloquence that was "created" as a style mainly by Elizabeth Shumann, who sang Strauss opera, and sang Strauss songs with the composer himself on tour during the Twenties. Della Casa's voice is better suited to the intimacy of the Lied, the short German song to piano accompaniment, than is Schwarzkopf's.

They are lovely, these songs, and of a surprising variety. Della Casa's best tones are ravishing; her flexibility, for the characteristic Straussian leaps and jumps, is no less than remarkable, and she always hits the big high notes exactly on pitch and in perfect voice. But two things detract somewhat from perfection. First, her diction is *not* good. Clear, persuassive "speech" is the essence of German song. Second, between the big notes, her pitch tends to be a bit inaccurate (she's always there when it counts), making it hard to follow the sense of the rapidly shifting Strauss harmonies. (Schwarzkopf outclasses her easily on these points.) Arpad Sandor is the experienced and very musical pianist.

Maria Callas—Arias by Beethoven, Mozart, Weber. Paris Conservatoire Orch., Rescigno.

Angel 36200 stereo

Inevitably, after running through practically everything else, Callas has got to the ultimate classics—Mozart, Beethoven and the arch-German-Romantic, Weber. A long step from her more spectacular roles in high-Italian opera. And it makes a pretty wild record, too. But not as bad as I expected—for I'm no Callas fan.

She really has a hideous voice for most music. There is only ony way she can use it—loud, blasting, superpowered. Every tone comes straight from the chest, preceded by a grunt, as though the compression were too high. It probably is. There's only one position on her control board—full power. And she has a vibrato like none I've ever heard; it seems to be a sort of compound vibration, several frequencies superimposed, intermodulated all over the place. It gets slower as she sings higher. Her diction is non-existant (except for the grunts and the enormous rolled Rs); her vowels are even less; she sings with soap in her mouth as far as intelligible language is concerned. And she sharps the high notes, as well as singing them invariably at top volume, regardless. . . .

All this is plain dreadful for Beethoven (in his classic detached aria "Ah, perfido!") and even worse for Mozart, though not quite so bad for the more Romantic Weber. (But what incredible English she sings!). And yet—oddly enough, one can see why La Callas has made such a whopping impact, even though here she is invisible and non-temperamental, in recorded form. She works hard, she tries hard, and she *is* dramatic. There's nothing weak for a moment about her singing, neither in the voice nor in the projected personality, and this quite aside from her undoubted visual impact on a stage. It's just that she *sings* so badly. . . .

Stravinsky conducts Firebird, Petrushka, The Rite of Spring. Columbia Symphony Orch.

Columbia M3S 705 (3) stereo

This is a monumental evening—full of music and worth any listener's evening, too, the latest in the long series of Stravinsky-conducted Stravinsky from Columbia. Here is the old master at 82 going back to his three famous early ballet scores once again, for a near-definitive stereo recording that will no doubt be his last; here are his own last thoughts, so to speak, upon these works of so long ago, after, as he puts it, "fifty years of destructive popularity." It must be really strange to have your own revolutionary works first become acceptable, then familiar and finally very nearly old fashioned. And to conduct them a thousand times, as he has done the Firebird. . . . !

It is the Firebird that comes through most strangely here; for this first of his big works (1910) is the only one that he feels was not really original, not yet mature. Accordingly, one can sense a curious restraint in his conducting of the complete score, as though the old-fashioned Romantic aspects of the music, so zestfully taken up by conductors for fifty years, were distasteful to him. In any case, the complete ballet—very long—is in its whole much more modern and more dissonant than the famous dance excerpts one usually hears in the short Firebird Suite, where the Romantic elements seem to have been concentrated.

Petrushka is suddenly alive and full of healthy vigor and the famous "Le Sacre," the Rite of Spring is terrific. In these, Stravinsky still feels at home, straight through. Both are done with dramatic impact and if a few parts are a bit clumsy or underplayed (as compared with slicker versions by the big pro conductors), then there are innumerable interesting details that only the composer would think of bringing forward to our notice. Both ballets are done, like Firebird, in their complete form, more familiar to us than the complete Firebird.

Stravinsky is the most word-happy composer since Schumann or Berlioz—his notes for the album give a running account of the circumstances of the writing and production of each ballet that is fascinating and of first-rate historical value as well. (We find in them that Stravinsky thinks Walt Disney's "Fantasia," using part of the Rite of Spring, is an "imbecility" and the performance—it was with Leopold Stokowsky, wasn't it?—was "execrable". Ouch! Take *that*. Well, I liked that part of "Fantasia" with the popping volcanoes, myself. I like Stravinsky too.)

Beethoven: Symphonies No. 1, No. 2. Pittsburgh Symphony, Steinberg.

Command CC 11024 SD stereo

Beethoven: Symphony No. 5; Mozart: Symphony No. 41 ("Jupiter"). Cleveland Orch., Szell.

Epic BC 1282 stereo

Here are two European-born conductors, long since Americanized, leading comparable American orchestras in the music Europe knows best. For the phonographic ear—long familiar with Europe's own interpretations via thousands of records—both these discs show instant American characteristics. The Steinberg Command record from Pittsburgh is a good one of its sort. The Szell-Epic disc from Cleveland rubbed me the wrong way straight through.

Steinberg has taken on some of the typical American toughness and his two symphonies both show no sentimental nonsense, but keep right to the point with a bit more than a minimum of delay. Nevertheless, Steinberg shows (and his men project) a very human

(*Continued on page 79*)

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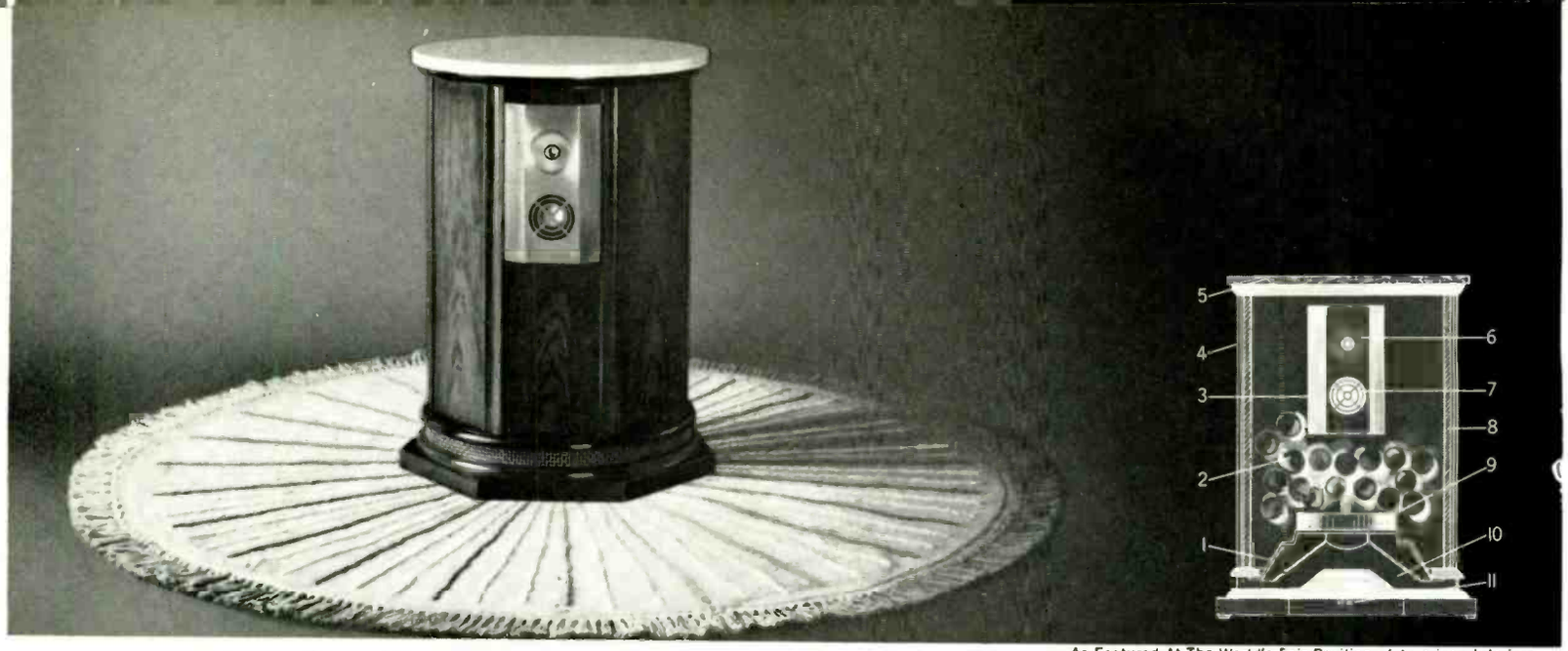
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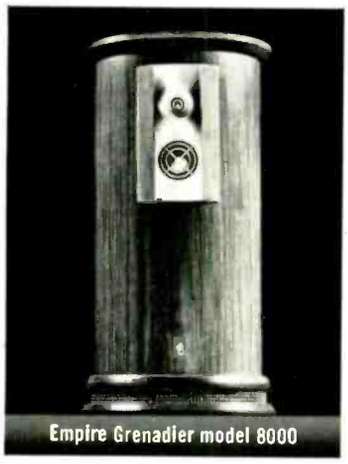
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Model 9000M outstanding features:

1. 15" mass loaded woofer with floating suspension and 4" voice coil.
2. Sound absorbent rear loading.
3. Die-cast mid frequency-high frequency full dispersion acoustic lens.
4. Hand rubbed satin walnut finish.
5. Imported Italian Perlata marble.
6. Ultra-sonic domed tweeter.
7. Full presence mid range direct radiator.
8. Exclusive non-resonant rigidized heptagonal sonic column.
9. World's largest (18 lbs.) speaker ceramic magnet structure.
10. Front loaded Horn—360° aperture throat.
11. Complete symmetry of design with terminals concealed underneath.
12. Dimensions: height 29" — diameter 22".



Empire Grenadier model 8000

Started a new era in speaker systems. Measures 29" high with a 15¼" diameter. Its features are virtually the same as the 9000 plus the exclusive Empire Dynamic Bass Reflex . . . high Q reflex tuned columns for in-phase low frequency reinforcement. The scientifically accurate gradients and vented ports provide unbelievably enriched base response.



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You will notice no change in sound level of bass, mid range, and highs. Full frequency and separation is assured by Empire's exclusive divergent acoustic lens system.

Try this same test with any other brand of speaker. Some speakers will only have a narrow angle of high frequency sound propagation. Some may have 2 or even 3 bands of high frequency sound. With these or other speakers, slight shifts of position, turning one's head, or even leaning to one side may cause sharp changes in the listening tone and level. Not so with the Empire Grenadier.



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Its satin walnut finish is designed to blend with all furnishings. An imported Italian Perlata marble top is optional for added elegance on the model 9000. The Empire Grenadier is a truly beautiful and functional achievement in sight and sound.

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A Basic Course in Commercial Sound

NORMAN H. CROWHURST

Chapter VII

Amplifiers and Electronic Equipment

The amplifier is probably the last thing you think of, in figuring out most commercial sound systems, which is as it should be, because only then will you have enough facts to see what you need. First question, as a matter of size, is how much power? If you have estimated the number of speakers and their placement, and added up the power they will take, then you know how much power the amplifier needs to give.

At one time, high power amplifiers were so costly that you'd probably have to refigure the whole thing, otherwise your competitor would under-bid you, by estimating on about half the power you consider to be necessary. Fortunately those days are gone. Providing enough audio power is not the problem in cost that it used to be. But it may be worth considering how many power units to use. In a large installation, if the sound is always integrated—that is, the same program sound always goes to the entire installation—then one big amplifier, or if a single one does not come in big enough size to supply the whole installation, a minimum number of the biggest available size, might be the simplest and least expensive solution.

A question that can change this picture is the need for standby. If an amplifier should fail, how can service be maintained until repair is made? If an installation uses a total of 500 installed watts, in 100-watt units, one 100-watt standby unit would be sufficient to substitute for any of the units in service, should one fail. Reliability is such that failure of more than one unit at a time is unlikely.

Suppose that 100-watt units provide power at $1.20 a watt ($120 an amplifier), so the 500-watt installation would cost $600 for the power units. With one standby, the total cost is $720. Now suppose a larger unit, capable of 250 watts is available, making the cost $1.00 a watt ($250 per amplifier): would this represent a saving? On the operating wattage, it would. Total cost would be $500. But standby costs another $250, making the total cost $750—$30 more than the system using 100-watt units. Or if units of 500 watts make the cost 90¢ a watt: one amplifier for operating wattage would now cost only $450, but another whole amplifier for standby raises the cost to $900.

On the other hand, 50-watt amplifiers would probably cost, using the same pricing scale, which is subject to dramatic change with the times, about $1.50 a watt ($75 per amplifier). So it does not follow that the smaller the amplifier unit, the lower the total cost, including standby. In this case, the total cost is $750 without standby, or $825 with. Assuming the prices named to be applicable at the time we are costing it, the 100-watt size would be best for the installation size we need.

But modern techniques are continually revising prices—those figures may not be realistic by the time this is printed. The only way to decide is to get *current* prices and figure it out.

If you need multiple amplifiers to supply different programs simultaneously, rather than a single bank to supply integrated program, then the exact number chosen may have to depend on the application, rather than on simple economic factors. For example, there may be three major service areas, which may require either the same program together, or separate programs, according to the functions being served. In this case you really have three systems to consider, each with its own power requirements, except that controls may be more or less centralized, and you may be able to pool resources for standby purposes.

In that discussion, we have considered the power amplifier as an entity separate from the "front end" or control amplifier. In big systems this will usually be the best arrangement. Where a number of power units serve a whole system, it is virtually essential to think in these terms. But for smaller installations, where only one power unit will easily serve the whole system, one of the combination units will save both cost and space. In this case, because it doubles the cost of the whole

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unit, standby is hardly worth considering, unless the source of supply for amplifiers is too far away, so that replacement could take longer than could be allowed, in event of failure.

Whether the "front end" facilities come as part of a combined unit, as a separate control amplifier, or as units to be built into a control panel tailored for the job, consideration of an installation's needs will be much the same. Where a control desk is built up of individual components, of course, the assembly can be tailored exactly to the installation's needs. Where a ready-made combination amplifier, or control unit is used, one must be selected that comes nearest to filling the bill, or which does so with least redundency.

Inputs

Sometimes an installation is required for one quite specific need, say just for public address reinforcement, with a single mike at the speaker's platform. This seems to be a job for a single amplifier with a single microphone input. No occasion for any additional inputs. That would be a short-sighted notion. It is only a matter of time, after an amplifier has been installed, before someone thinks of some other use that could be made of it. Such an amplifier should at least provide for an additional mike input, phono, radio or tape inputs.

Actually, there is no specific distinction between some of these inputs: inputs at different levels and impedances may serve more than one of these functions, under differing circumstances. The most useful general purpose input is one that accepts about a volt (maximum) at high impedance, with means to control gain from it. This can then be used for a radio tuner, tape recorder, or the output from a phono preamplifier, or even from phono direct, if a ceramic

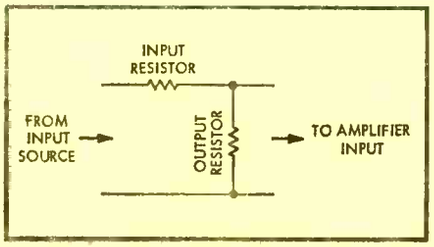


Fig. 9-1. Form of attenuator to use where high-level source is connected to low-level input.

pickup cartridge is used, and the input impedance is high enough.

For the more conventional magnetic pickup, a phono input requires equalization of such magnitude that something is very obviously wrong if you don't provide it, so a special phono input is needed for this, unless you have a separate preamplifier with equalized phono input.

For all inputs, it is important that both level and impedance should be right—or at least within a satisfactory workable range. A low-level source, such as a microphone, magnetic phono pickup, or anything else, that gives only millivolts of input, will not work when connected to a high-level input, requiring something of the order of a volt. The level is so inadequate it will give the impression nothing is working at all.

Conversely, a high-level source, such as the output from a radio tuner, preamplifier or professional tape recorder, cannot be connected to a low-level input, without some attenuation. Normal gain or volume controls cannot handle this much range. Attenuation is relatively simple to insert. *Figure* 9–1 shows the basic configuration suitable for most jobs. Values may be calculated quite simply. There are two starting points.

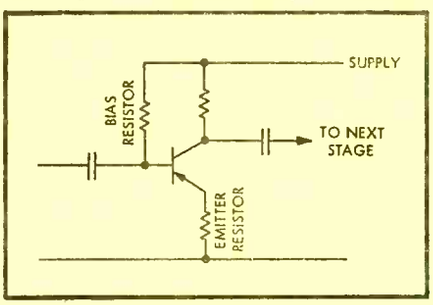


Fig. 9-2. Relevant circuit values in transistor input circuit.

(1) Make the output resistor suitable for the input circuit (not higher than about 50k for tube amplifiers). Then find the series input resistor by multiplying that value by the attenuation factor required: for 20 db, a factor of 9, for 30 db, a factor of 30, for 40 db, a factor of 99 (100 is near enough).

(2) Check that the input resistor so calculated suits the source. If it is too low, a somewhat higher output resistor may be used, so long as the correct ratio is used. For transistor circuits, the output resistor should be equal to the nominal input impedance of the transistor circuit, or higher.

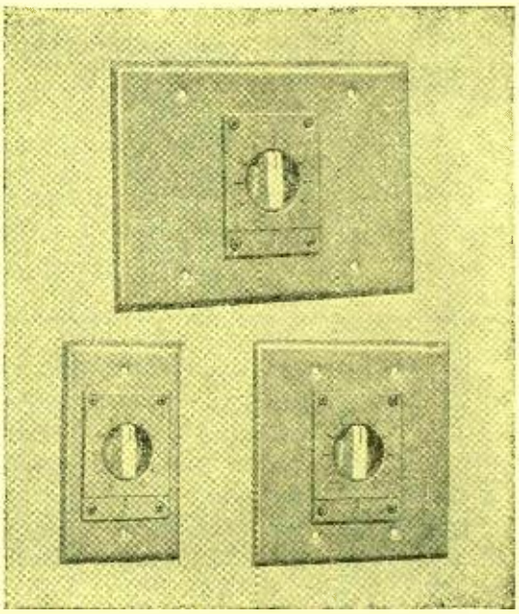
Impedance has to be of the right order, as well as level. Three varieties of resistive impedance should be distinguished, which does not include the input for ceramic mikes or pickups. Low impedance, usually meaning around 50 ohms, such as a moving coil mike with no transformer. Line impedance, which usually means 500 ohms in this country or 600 ohms European standard. Newer standards are 125 ohms, 150 ohms and 250 ohms. Matching to a line impedance, but the wrong nominal value, is not very serious. Connecting a 500- or 600-ohm source to a 125- or 150-ohm input will probably give more gain, with a slight loss of highs. The other way will lose a little gain, with no noticeable effect on quality.

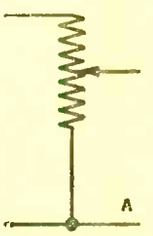
Input impedance can be matched by transformer, usually to the grid circuit of a tube. In this case mismatching can change frequency response, as well as reducing gain. In transistor amplifiers, input matching is achieved by choice of circuit values, so the transistor naturally matches the source and gives best gain and operating condition with the specified impedance. *Figure* 9–2 shows the relevant factors.

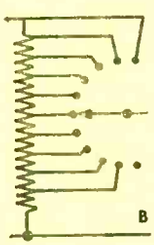
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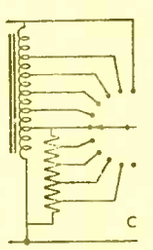
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MODEL	LC8/5	LCP8/5	LT8/10	LTP8/10	LVP10	LVP35	LVP75
Nominal Imped., ohms[1]	8	8	8	8	—	—	—
Power Rating, watts[2]	5	5	10	10	10	35	75
Type	Variable R.	Variable R.	Tapped R.	Tapped R.	Autotrans.	Autotrans.	Autotrans.
Circuit	A	A	B	B	C	C	C
Switch Positions	—	—	11	11	11	11	11
Attenuation/Step	Continuous	Continuous	3 db	3 db	3 db	3 db	3 db
Attenuation Range	> 30 db & OFF	> 30 db & OFF	27 db & OFF	27 db & OFF	27 db & OFF	27 db & OFF	27 db & OFF
Bridging Loss (Max.)	1.0 db	1.0 db	1.0 db	1.0 db	.7 db	.3 db	.2 db
Switch Plate	None	Single	None	Single	Single	Double	Triple
List Price	$5.00	$6.00	$10.00	$11.00	$15.50	$16.00	$18.50

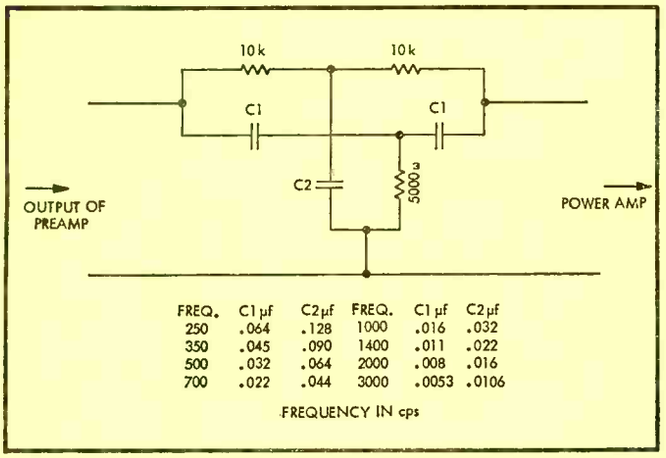
1. Nominal impedance of controlled loudspeaker load.
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FREQ.	C1 μf	C2 μf	FREQ.	C1 μf	C2 μf
250	.064	.128	1000	.016	.032
350	.045	.090	1400	.011	.022
500	.032	.064	2000	.008	.016
700	.022	.044	3000	.0053	.0106

Fig. 9-3. Frequency elimination filter for insertion between amplifiers.

For input stages the bias is usually taken from supply minus (using PNP transistors), through a high value resistor, which controls the current to operate the transistor at maximum gain, minimum noise. The input impedance presented at the base then depends on the resistor between emitter and supply plus (ground), being approximately the value of this resistor multiplied by the working current gain of the transistor.

Use of too low an emitter resistor results in the source being loaded down by the amplifier's input impedance, but will also yield a slightly higher power gain (1 or 2 db). So effective gain may increase a little, usually at the expense of distortion, because the transistor's input resistance becomes non-linear to an unnecessary degree. Use of too high an emitter resistor results in reduction of current input accepted from the source, and thus loses gain. It may improve linearity in some cases, but the improvement is costly in terms of lost gain.

Response Tailoring

Under this heading we consider the various special features that enable the commercial amplifier to specially adapt to conditions peculiar to an installation. For portable work, where the same amplifier is to be taken to a variety of halls, a really flexible "tailoring" circuit is needed. Simple bass and treble cut and boost are seldom adequate, because they will cut or boost at the wrong frequency much of the time. In some buildings it is not merely a matter of correcting balance, but of compensating for a coloration peculiar to the building. A really comprehensive circuit may control gain in 5 to 10 separate audio bands, but a few as 3 (low, middle, and high, with transitions at 500 and 2000 cps) can be used very effectively for most jobs.

Response tailoring for commercial sound systems is not only a help to make sound more pleasant. Often it may be needed to reduce a tendency to acoustic feedback, so more effective gain may be used. An extreme measure of this kind is a tunable absorption filter, that completely eliminates one frequency from the amplification. The theory on which this was developed was that the feedback frequency can be eliminated, enabling gain to be turned up for all the other frequencies.

Figure 9–3 shows the basic circuit used to produce an absorption characteristic. It can, if needed, be inserted between the preamplifier output and the power amplifier input, if such a circuit is not part of the facilities provided in either amplifier. For perfect null each of the series elements should have a value (resistance or reactance at rejection frequency) twice that of the shunt elements. Values for the capacitors can thus be obtained from a reactance chart. Some typical values are tabulated in *Fig.* 9–3.

Making either resistors or capacitors adjustable makes the rejection frequency adjustable. For perfect rejection, precision components must be used, but for minimizing acoustic howl perfect rejection is not necessary. A relatively poor rejection filter will do as well as a good one, because other frequencies not far away will be waiting to howl as you turn the gain up more.

One could go on eliminating more frequencies by using extra rejection filters, but every time a howl starts the method becomes less effective, in terms of extra gain. Actually a broadly tuned rejection filter, that reduces a whole range of frequencies by 6 to 10 db (*Fig.* 9–4) may prove more useful. This filter takes out a couple of octaves centered on 1000 cps, reducing them by 6 to 10 db. Such a filter, like the attenuator of *Fig.* 9–1, must be well shielded (enclosed in a metal box) to avoid hum pickup.

A better, but much more expensive method of reducing acoustic howl, where it is a severe problem, is the use of frequency shift. This takes the program material, converts it to a much higher frequency by frequency conversion, like that used in a superhet for radio reception, and then converts it back to audio frequency, with a difference of about 5 cycles from the original.

(*Continued on page 83*)

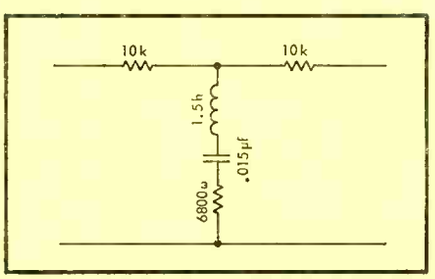


Fig. 9-4. A broad rejection, or hole, circuit that can help with howl-back problems sometimes.

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Audio & Hi Fi in West Germany

C. G. McPROUD

The large variety of German-made products prompted this observer to visit a number of the principal manufacturers in West Germany whose products are familiar on the U.S. high fidelity market. As a result, this review of the West German (and, digressing slightly, the Austrian) audio and hi fi industry is presented for your entertainment and edification. Seeing the products in their home grounds offers some explanation for their high quality and range in design that lends much of the aura to imported components. In short, here is a travelogue as experienced by a typical audiofan.

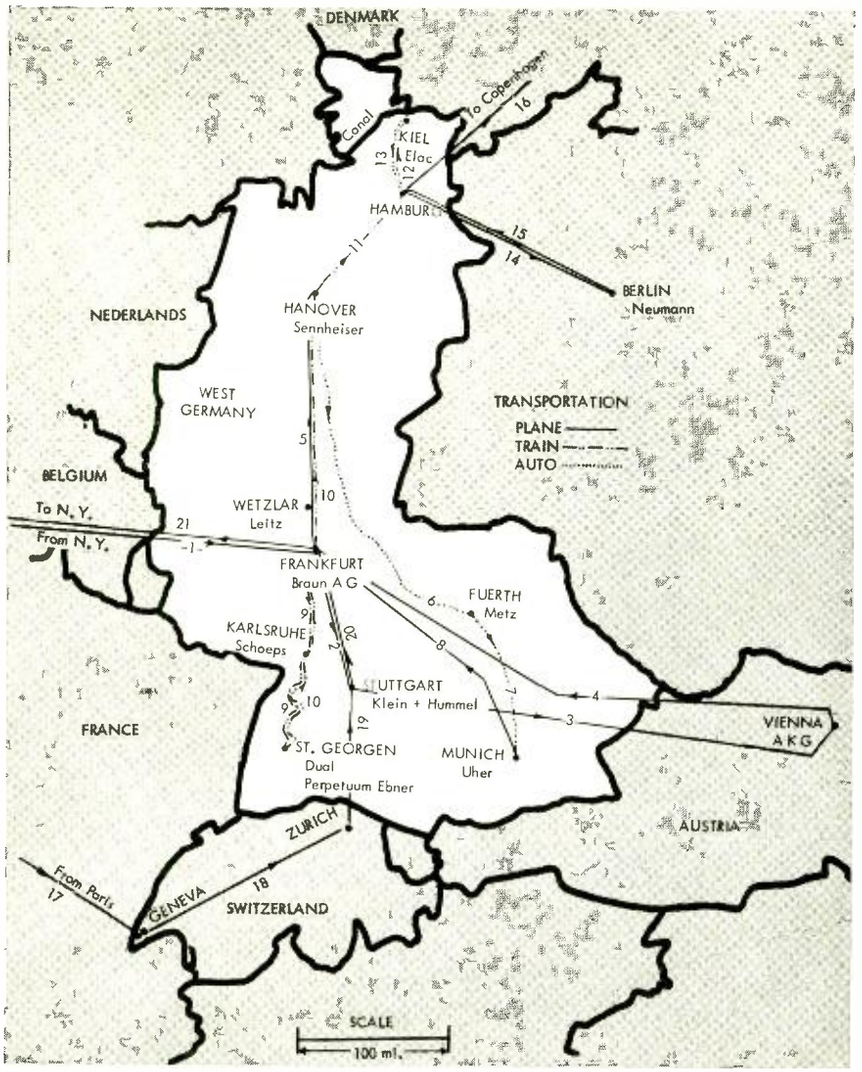
ONE CANNOT OBSERVE the high fidelity scene in the United States without noting that there is a large variety of products which do not originate here. Among them are, first and certainly largest in total value, tape recorders, with an enormous supply coming from Japan. Record changers or automatic turntables or whatever they may be called, along with their associated products such as arms and single-play turntables, come to our markets principally from the European countries, including Great Britain. Europe also seems to be the principal source of top-quality condenser microphones, with the U.S. manufacturers leading in top-quality dynamic types.

A little over two years ago, this writer was privileged to be a member of a group of four magazine representatives who were guests of the Electronic Industries Association of Japan for a visit to the industry in that country. Besides having the opportunity of attending the first Japan Electronic Show, we were treated to a number of trips through the plants of members. Although there are over 500 members of the EIA-J, we were able to visit only eleven factories during our stay in Japan. Our own review of the trip, and the hi-fi aspects of the electronic industry there, appeared as a special section in the March, 1963, issue.

Since this trip was a delightful and informative experience, and since there are so many products imported from Germany, the writer began planning aimed at a similar visit to the home of Miracord, Uher, Dual, and a host of other products. And because time is always limited, plane travel was indicated, and when one thinks of Germany, one automatically thinks of Lufthansa, the German airline.

Hoping to arrive during the enormous International Trade Fair—the Messe—at Hanover, where everything can be seen under some twenty five roofs (and on something like fifty acres of open-air display areas used for road building machinery, locomotives, cranes, and other such industrial behemoths too large for the exhibit buildings), we enplaned on

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Map of territory covered showing cities visited and the manufacturers in them. Numbers along the travel paths indicate the order in which they were made—a somewhat less than efficient or economical routing

April 28 bound for, of all places, Stuttgart. We, in this instance, represented self, wife, secretary, and severest critic, the latter three being one person.

West Germany is not a large country when compared with our own. It encompasses nearly 96,000 square miles, or about equal to the total area of New York and Pennsylvania. One could fly from Kiel, almost at the northern boundary, to Munich, near the southeast corner, in less than three hours if Kiel had an airport, which it doesn't. By automobile it takes a lot longer.

Be that as it may, we arrived in Stuttgart on Lufthansa's inaugural flight to that city, and, having three days to kill before meeting our German contact in Hanover on May 3, we felt we could justify a trip to Vienna on the basis of visiting AKG, so we would start our inspection of German audio plants in Austria. This may seem ridiculous, but the plain truth is that if one is in West Germany, it is much easier to visit Vienna than if one is in, for example, Mineola. Furthermore, they speak what passes for the same language, and there is not much audio manufacturing in Vienna except for AKG so it would not be likely that we could make the trip for that sole purpose. We found out too late that Philips made some tape recorders in Vienna, but with Labor Day (May 1) and a Saturday and Sunday to follow, we couldn't see everything. We did, of course, attend one opera at the famous Vienna State Opera House. This building, about 80 per cent destroyed during the war, has been rebuilt in exactly the same style as the original, and with such care and attention to detail that it appears to be of the same age as most of the other buildings in the city. The interior is new, though retaining the flavor of its era, and was designed under modern acoustical principles. To the listener, it appears to be just about perfect for operatic performances, and it provides the quality of "transparency" often referred to with regard to true classical pipe organs when each rank of pipes must stand out separate from all the others. Each instrument in the pit orchestra can be heard clearly and separately. The same clarity is also evident from the vocalists. The mechanical facilities of the stage are completely modern, and we were told that the stage was essentially an elevator having at least six separate levels, on each of which could be built a set so that scene changing can be accomplished in a minimum of time.

After the usual sightseeing in Vienna, we again took to Lufthansa for the trip to Hanover, changing planes at Frankfurt, and arriving in a drizzling rain late enough to preclude visiting the fair that day. After settling in—and make sure that you have a place to settle in before undertaking a visit to Hanover during the ten days of the fair—we got set to go the next day. Hanover proper has a population of 575,000; with outlying districts, its total adds up to 710,000. During the ten days of the fair, it is usual for 500,000 people to attend. Thus the population nearly doubles for those few days, so it is obvious that accommodations are scarce. Hotels—the few there are—are booked for years in advance. The fair management canvasses every home in the city for spare bedrooms, classifies them as to quality, then assigns them much as a room clerk in an enormous hotel would. Householders with spare rooms furnish "bed and breakfast" at a reasonable cost and collect from the guests—there is no central bookkeeping system and cashier.

The fair itself is beyond comprehension. The directory lists nearly 8000 separate exhibiting companies whose products range from small jewelry items to building-engineering machinery, mining equipment, railway cars and locomotives, oil well derricks and drilling machinery, office equipment, china, and finally, radio, television, and sound recording and reproducing equipment and components. The fair covers an area about a mile square, with twenty five "halls" for exhibit space, some with several floors. There are fifteen eating places, ranging from milk bars to formal restaurants, one of them at the top of a pair of 150-foot elevator shafts. One couldn't possibly see everything in the ten days, even if he spent all of every day walking and looking.

Consequently we spent practically all of our time in the radio and television hall and we still didn't see everything there. However, in this hall, the fair was just about the same as an enormous audio show except that all of the signs and most of the literature are in German. Guides are available for those not familiar with the language, so that information can be had even where the ex-

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hibit attendants do not speak English. The directories—there are two, with one listing the exhibitors and the other a cross reference by product—are multilingual, having German, English, French, and Spanish sections.

The fair closed on May 5, and we spent the next day on the famed autobahn traveling to Fuerth by car, a 450-mile journey. Traveling in Germany during April and May with the avowed purpose of visiting manufacturers is filled with pitfalls—it is difficult to find anyone during the month before the Hanover fair, and for the month after they are all resting up and entertaining potential buyers. In addition, the month of May has innumerable holidays—the 1st is Labor Day, the 7th and 17th are religious holidays, the afternoon of the 18th is a local holiday in Frankfurt. And of course, every week has its Saturday and Sunday. As if that weren't enough, many people take their annual vacation during May.

Figure 1 shows our routing throughout Germany—an extremely inefficient jumping back and forth which was dictated by the availability of people whom we wished to visit. Note that we arrived first at Stuttgart, thence to Vienna, back to Hanover, then to Fuerth, Munich, Frankfurt, St. Georgen, Karlsruhe, Hanover again, Hamburg, Kiel, Hamburg, Berlin, Hamburg, and thence out of Germany to Copenhagen on the 25th. After a quick run-through of Sweden, Oslo, London, Paris, and Geneva, we returned to Germany at Stuttgart on June 10, went on to Frankfurt again on the 11th, visited Wetzlar on the 14th, and returned to New York on the 16th.

To an audio-minded reader, Wetzlar may seem a bit out of place, so a word of explanation is necessary. We have noted that many audiofans are also interested in photography. Perhaps we have noticed this because photography is our own second hobby, and we are thus slanted in that direction and conscious of the tendency in others. Our stable of photographic equipment has long included at least one Leica, sometimes two, and many of our pictures in this magazine over the years have been taken with first a IIIC, then a IIIF, and currently an M2. Like any good Mohammedan who gets within range of Mecca and must, perforce, visit it, we looked upon Wetzlar as our mecca, and the trip would not have been complete without a call at the home of the Leica. With little pre-arrangement, we were cordially received, our questions answered, and our interest in the factory appeased by a trip through it. The hardest part of the trip from Frankfurt—about 50 miles—was after we got into the town of Wetzlar. We could see the factory from anywhere in the town, but we couldn't find a road which led to it. Consequently, we explored some back streets, got into the parking lot of a brewery (and out again without stopping) before we finally found Leitz with the aid of some helpful natives. The average Leica user may not know it, but the company runs a three-day "school" every Monday, Tuesday, and Wednesday, covering the camera and its use in the mornings and with field trips in the afternoons—all free of cost. Arrangements can be made through Leica dealers, or E. Leitz in New York.



View of Wetzlar, Germany, with Leitz plant in foreground

Back to audio subjects again.

We visited a number of the factories wherein are produced the items which appear on the hi-fi market here. There are also a number of other manufacturers whose plants we did not visit—names which may be familiar in the U.S., but which are not sold on the component market. In general, the average "package" radio set or phonograph just does not come up to the standards of the U.S. hi fi component market, which is the market in which we—all of us—are interested. We will, however, describe those companies we did visit after a general coverage of economics in West Germany.

Economics of Imports

The whole business of importing from foreign countries must be predicated on differences in cost of production. A pound of raw copper, for example, will cost just about the same (in U.S. dollars) anywhere in the world. Fabricated into a finished product, the cost is likely to vary over a wide range depending on the cost of labor in the country in which the work is done. This must surely be a basic law of economics, for it may be assumed that it will take the same number of man hours to perform a given job whether it be in Hong Kong, Africa, India, Japan, West Germany, Great Britain, or the United States of America. Any variances must come from the amount of automation employed.

This, in our opinion, constitutes the main reason why imported goods are so often less costly than the same products made here at home. Aside from the differences in craftsmanship—and here we could easily encounter a wide disparity of opinion—a given product of the same quality, using the same basic raw materials, should require the same number of man hours to produce anywhere in the world.

If, however, the wage rate in any given country is different (again, in U.S. dollars) then the cost of the finished product will differ in proportion to the difference in labor cost. It matters not that the workman may be able to live just as well on a wage corresponding, let us say, to 25 cents per hour, as his counterpart in the U.S. does on $3.25 per hour. This is, of course, an exaggeration, but 25 cents per hour may very well be considered a good wage in Hong Kong, for instance.

It is true, of course, that the cost of labor is increasing throughout the world—in West Germany, it has increased more than 42 per cent in the last ten years—and sooner or later there will not be such a spread between the wages paid (in U.S. dollars, again).

In comparing costs in some of the West German factories, we find that wages range from 2 to 7 DM (Deutsche Mark = approximately 25 cents) for the various types of labor, or a range from 50¢ to $1.75 per hour. To this must be added a 13th month each year paid as a bonus at Christmas time—a practice common in West Germany. In Austria, a 14th month is often paid for a vacation and in certain types of offices a 15th, or half a 15th, is also paid as a bonus. Officially, banks pay 17 months, and unofficially, up to 20. In addition to the vacation payments, the employees are also given the vacations, so the payments are not *in lieu of* vacations, but money which can be used *for* the vacation.

In Vienna, labor costs are in the vicinity of 15 schillings (one Schilling =

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approximately 4¢) per hour, subject to the extra months mentioned. Living costs will run in the vicinity of 1750 schillings per month per person, with about half of that going for food. Rents are comparatively cheap because of controls which have been in effect since the country became a republic in 1918, and a small apartment might cost the equivalent of $2.00 per month. This militates against any modernization or any new construction, and consequently the living quarters are not up to the standards of most of Europe.

In Munich, in West Germany, a 45-hour week has been usual until recently, when a 43-hour week went into effect; unions are now striving for 40-hour weeks, all without any reduction in total take-home pay. Here, for a family of four, food will cost from $20 to $25 per week, and an apartment will cost from $20 to $40 a month. An average figure for a man's suit will be in the vicinity of 250 DM, or about $62.50

When this writer visited Germany for the first time in 1957, it was generally considered that the purchasing power of the German Mark was about equivalent to one dollar in the U.S. Now it appears that the equivalency is between two marks to a dollar and three marks to two dollars. This gives us cause to wonder just how long there will be any differential in labor cost between imported goods and those made here. It is already apparent in many goods in the stores, and the bargains are not as plentiful as they were as little as five years ago. Add to this the reduction of the exemption allowed tourists, and there is no longer the great advantage there used to be. Men's clothing and shoes are still a bargain in England; cameras of German make are still bargains in Germany; ties and gloves in Italy. But as comparative wage rates come closer, the bargains disappear.

The same thing applies to U.S.-made products on foreign markets. Import duties and shipping costs practically eliminate American cars from European markets. Tobacco products made in the U.S. are taxed prohibitively in Germany and most other European countries. We were sent two cartons of American cigarettes while in Copenhagen—a value here of $4.86 in the supermarkets. The post office endeavored to collect a duty of $16.50 for the two cartons, which were a gift in the first place. Fortunately, the postal clerk had a sense of humor, so when we insisted that we wouldn't pay it and offered them to him to smoke, he claimed that he couldn't take them; then we told him to throw them into the wastebasket, which also he couldn't do. Finally he offered to send them back to our home at no extra postage. In due time they arrived here, duty free.

Moral: *Carry* your cigarettes from country to country (or smoke local ones). There is no duty on reasonable quantities carried in your luggage.

The pay rates are usually doubled for overtime work, tripled for Saturdays, Sundays, and holidays, and after 10 p.m. Contributions are made into unemployment funds equally by both company and employees. Income taxes are of the same order of magnitude as in the U.S. One major difference in the taxation on income is that there is a ceiling of 50 per cent as the maximum tax, regardless of the amount of income.

In a country with a population of around 57 million, there is an astonishingly low unemployment figure of only 100,000 people, and this figure includes those who are unemployable, ill, changing jobs, or who just won't work. Against this small number of unemployed, there are some 600,000 job openings, which accounts to a large extent for considerable immigration from Italy, Spain, and Portugal. In the southeast areas, there are large numbers of Jugoslavian workers. In practically every company we visited, we were told that they had trouble getting enough factory labor. One factory manager told us that they had advertised every day for a month in the classified columns and received only four replies.

Not available for local labor, of course, are the 500,000 or so Americans—Army and Air Force personnel and their families—who are in West Germany. A large percentage of these live in housing provided by the services, though because there are not enough housing facilities available for all, many live "on the German economy" which means that they rent housing owned by German citizens and in general live like the "natives." As a rule they do not mix with the German people, and relatively few of them actually take advantage of their opportunity to learn to speak and understand the language. Two tabloid-type weekly newspapers devoted entirely to the military personnel and their families are published in Frankfurt—*Overseas Weekly,* presumably read primarily by service people who are without families, and *Overseas Family,* with greater appeal to the home reader.

To the outsider who observes these conditions, it would seem as though it might be possible for service wives who are not tied down by the need to care for children to work part or full time in factories near their homes and thus increase the family income slightly as well as help the German economy still further.

Traveling in Germany

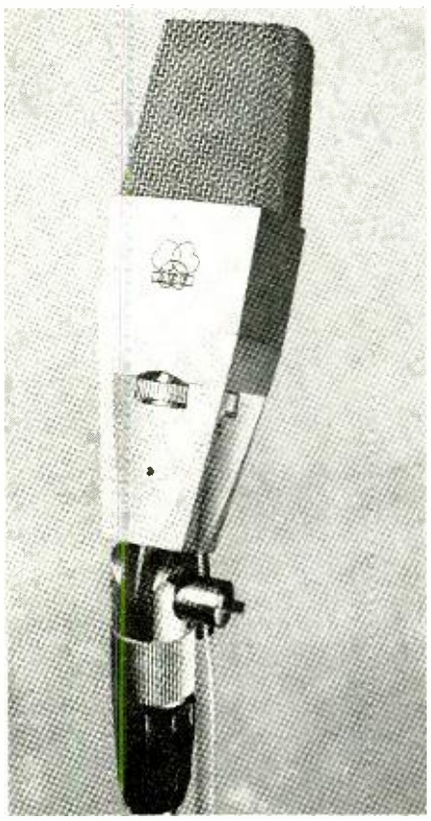
For the tourist, there is much of interest in West Germany, and as long as he stays in the larger cities there is never any difficulty with the language. AUDIO is, naturally, on the exchange lists of magazines throughout the world, and after many years of scanning foreign publications, the writer had acquired a certain familiarity with technical German, as well as with several other European languages. However, while one may "read" a technical article in German, and may even understand an engineer speaking in German with a description of a circuit or a process, one may find that he is hopelessly lost when he tries to buy a railroad ticket or asks a native for directions to some place. As most tourists do, we naturally secured a typical "phrase book" so that, according to the advertisements extolling the advantages of such a book, we could talk to the people, ask directions, and so on, with complete assurance that we would be understood.

Assuming that one masters the phrases perfectly and can ask any question in the local idiom and with correct accent and intonation, he then feels that he can walk up to a native and ask "Which is the way to the airport?" and get the correct answer. He does, of course, in machine-gun-rapid German.

The native, hearing a question in "perfect" German, assumes that the questioner knows the language, and consequently he replies as he would to another German. Your phrase book would not likely have the exact reply you received, and you therefore get no usable information at all. Better that you should ask the direction in English; the native then knows you are American, and will reply accordingly if he knows the language; if not he will either tell you he doesn't understand or, more likely, he will direct you to someone who does. This does not apply only to Germany, of course; it applies in any country where you are not familiar with the language. It is always desirable to *try* to learn something about the language before visiting a foreign country, and to *try* to speak it and understand it while you are there. Nothing seems to warm a "foreigner's" heart so much as to have a visitor to his country make an effort to understand his language. Of course, in his country, he is not a foreigner—you are. And that is one thing a traveler should not lose sight of for a minute, no matter where he is traveling.

Another aspect of traveling that seems to confuse many people is eating. We have often observed that tourists—and principally Americans—tend to try to find exactly the same foods in foreign countries that they are accustomed to eating at home. At dinner time they look for a big steak; for breakfast they ask for ham and eggs; and they expect to find a dry martini or bourbon-and-branch-water at cocktail time. We remember meeting some friends in Paris once who insisted on drinking a U.S. bourbon at 43 NF (new francs) a bot-

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AKG C-12A condenser microphone

tle—about $8.50—whereas Three Star Hennessey costs only 14 NF, or less than $3.00. So we offer cardinal rule No. 2 for travelers: Drink the local beverages (except, in some localities, not the water).

As to food, this writer has always believed that one should try something new whenever he has an opportunity—he might just like it, but even if he doesn't, he can always eat another meal the next day. Strange though it may seem, it is not likely that unfamiliar food will ever hurt anyone—it doesn't seem to bother the people who eat it all the time—and if you should like it, you have added a new gustatory experience.

Food in Germany is not exotic nor unusual. It is primarily good, solid, and substantial. Kartoffel (potatoes) in one form or another will be a part of every meal except possibly breakfast. And the forms in which potatoes are served are —at least to the writer—all exceptionally tasteful. This may be the result of a prejudice, for to us, potatoes are good in every form. This also applies to rice, starting with sake and ending up with rice pudding.

Beef is not especially common on German menus, since, as in Italy, they never seem to let their calves grow up —they slaughter them early and serve them as veal. But there is nothing wrong with a properly prepared wiener schnitzel, which can be had all over Germany as well as in Vienna. Then there is the wide variety of sausages—from foot-long Frankfurters to three-inch diameter Thuringers, and a few dozen others in between. Vegetables are a treat, too, with the 10-inch long creamy white asparagus leading the list in the spring—a form in which it never seems to appear in the U.S. On the whole, eating is a real treat in Germany (or, to some of us, almost anywhere).

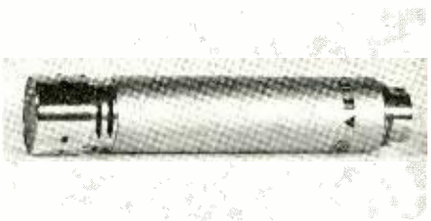
One delightful custom that is not so common in the U.S. as it is throughout the Continent is that of the afternoon coffee. Almost any city has hundreds of "konditorei" (from which probably comes the "candy store" here) where luscious pastries are served with coffee during the 3–5 p.m. hours. These pastries, generously laden with chocolate, candied fruits, and so on, are at least a feast for the eyes, though for calorie-conscious tourists who must eschew such delights, they are practically verboten. The coffee, too, is superb (it ought to be—in raw form it costs about three times what it does here) stronger than usually served in the U.S. and of a rich flavor. (Excuse us while we call up Lufthansa to arrange to go back.)

Visiting the Factories

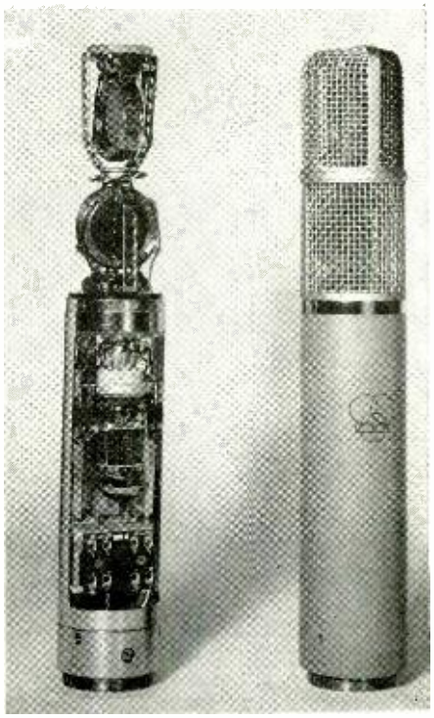
Since the principal reason for visiting Germany was to see how the factories worked, and how the many products imported here came into being, our impressions of several of them may possibly be of interest to our readers, along with some of the companies' histories, the magnitude of their business, and the distribution of their output. While this is primarily a story about the German audio industry, we first visited a plant in Austria. From the standpoint of chronological order, as well as alphabetical, AKG, of Vienna, must come first, incongruous as it may appear.

AKG

Standing for Akustische und Kino-Geräte GmbH, these three letters have come to be almost synonymous with microphones. (At the risk of being either redundant or a showoff, let it be interjected here that the letters "GmbH" stand for Gesellschaft mit beschränkter Haftung which translates to "Corporation with limited liability." There are several types of companies in Germany, with letter suffixes following the company name like our "Inc." or the British "Ltd," and the suffixes describe the corporate structure. A.G. means Aktien Gesellschaft, similar to our corporation. K.G. stands for Kommandit Gesellschaft, which is similar to our "partnership," but one in which the partners may have different degrees of liability. These abbreviations may be encountered throughout this article, and will thus not need to be translated each time.)



AKG C-60 miniature condenser microphone



AKG C-24 stereo condenser microphone

The company was formed in 1945 for the production of acoustic, photographic, and electro-medical equipment, including loudspeakers for theater use. During the next few years, the production became specialized in the manufacture of microphones, and the present name was adopted in 1948, the same year that the DYN 200 K dynamic mike was introduced on the market. This model had an omni-directional characteristic, and its frequency response could, for the first time, compete with the condenser microphone, considered unrivalled up to then.

The cardioid dynamic was introduced in 1953, with models D 12 and D 45, both of which are still in the line and many in regular use in broadcasting and recording studios. Its first condenser microphone, the C 12, was later introduced, followed by several miniature models—the C 28A, C 29A, and C 30A. These can be extended in length for floor or table use by means of adapters which are, in effect, simply coaxial cables with a solid metallic tube for the outside conductor and equipped with fittings into which the head may be screwed and which, in turn, may be

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Demonstration of AKG headphones at Berlin Radio Show

screwed onto the amplifier case. Stereo demanded a special microphone which evolved as model C 24, which consists of two C 12 heads at right angles at the top of the amplifier housing.

AKG produces many of the inexpensive microphones which are being sold to manufacturers and industrial customers all over the world, often with "private brand" names on them. They are usually identifiable by the words "Made in Austria" somewhere on them, though not always, because of certain restrictions in some countries. The company also produces a line of high-quality headphones, some coupled with noise-cancelling microphones attached to one earpiece by a short boom.

One entirely new development introduced this year is the DX 11 Echo Microphone, which can add reverberation right at the microphone without any large or extensive additional apparatus. This model resembles a dictating microphone in appearance and contains a high-quality cardioid dynamic unit, a reverberation element—very much like a miniaturized spring-type Hammond device so familiar a few years ago—and the necessary transistor amplifier, control unit, and battery. Adjustable by a thumb wheel, reverberation time can be varied by the user from zero up to a maximum of 2 seconds. While this microphone may not be of recording quality, it can surely fill a need for singers in night clubs, general public-address use, and many other applications.

For measurement purposes, the C60 line of condenser microphones fills a need. Two heads are available—one omni-directional and the other a cardioid. An extremely wide range of models of all types, both dynamic and condenser, will accommodate any requirement.

Even though the output of AKG is approximately 3500 microphones per day, a large factory is not required because of the relatively small amount of material used in manufacture. Even the largest models are only about 45 cu. in. in volume, and the smaller ones around 7½ cu. in. Naturally the smaller models constitute the preponderance of the units shipped. Consequently very little actual raw materials are used, which means that a large plant is not necessary. Nevertheless, the company employs about 700 people, and the output of over 700,000 microphones per year means sales of the order of better than $4 million. About 95 per cent of the company's products are exported. Needless to say, the majority of microphones sold are of the less expensive types, but the highest-quality condenser units are priced well over $100 to the user, and the company makes around 2000 a year of these types.

A visit through the factory is something of an experience. Many companies feel that they have attained a pinnacle when they can boast having an anechoic chamber—AKG has 17 of them of walk-in dimensions, along with a number of smaller acoustic chambers for frequency-response measurement of *every* unit made. The curves are supplied with the professional models, but with the less expensive ones they are run just as carefully and filed for future use if necessary.

AKG microphones are distributed in the U.S. by AKG of America, a Division of North American Philips Co. Inc., 125 Park Avenue, New York 17, N. Y., and the headphones by Audio Applications, Inc., 19 Grand Ave., Englewood, N. J.

Friday, May 1, was Labor Day and thus a holiday, and therefore filled with celebrations and parades which, unaccountably, began at 7:30 in the morning just outside our hotel window. Thus we had an early start on our sightseeing, which continued through Saturday, also a day of no work with no factories open which we could visit. Sunday morning we entrusted ourselves to Lufthansa again for Frankfurt, a distance of 365 miles, and after a change of planes we found ourselves in Hanover—another 160 miles—and the scene of the previously described Messe. After two days there trying to see everything, we made an automobile trip to Fuerth—a small city near Nuremberg, in Bavaria. (See map.) May 7, being a holiday was an excuse for resting, but the 8th was another visiting day. This time it was Metz—a large manufacturer of radio and television products and, probably better known, electronic flash equipment.

METZ

Metz Apparatewerke was established some 25 years ago, originally as a manufacturer of capacitors and transformers for use by other manufacturers of finished products. After the war when FM started to get going in Europe, Metz began making FM tuners, again as a "private-brand" manufacturer, and during this period they had one order for 500,000 such units.

Fifteen years ago they began to produce radios under their own name, one popular model being a tube-model radio and amplifier combined with a 45-rpm phonograph, and designed for 110-volt operation, and thus for export to the U.S. During the later years, the company has made strides in both radio and television, with a wide line in both departments. More recently they have entered the photo-flash field with several models, both portable and for on-camera use.

Our interest in Metz centered about their entrance into the high fidelity market with several components, an area which has not been thoroughly explored yet in Germany. One of their first entries in this field was called the "Belform," and consisted of an automatic turntable in one package of the same style and size as a tuner-amplifier unit, together with a pair of loudspeakers of similar and closely matching appearance. The styling was unusual on the German market, which had long—and still has, in most lines—appeared in a form which consisted of a sloping front, a slide-rule dial covering several short-wave bands, the medium-wave or what we call the broadcast band, and "UKW" (ultra-short waves) corresponding to our FM band, all built into a mahogany-finish cabinet with a very high gloss—a style not currently in vogue in better American furniture. While the first Belform tuner-amplifier was similar with respect to the dial, the cabinet was long and low, and finished in an approximation of our familiar oiled walnut. Loudspeakers were in cabinets of similar size and appearance. A more recent model combines the turntable with a transistorized amplifier as one unit, also used with matching loudspeaker systems. A current model is a fully transistorized receiver for FM stereo, complete with automatic stereo switching, independent treble and bass tone controls on both channels, with push-button source selection, filters, and so on. This model is

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Main office and factory building of Metz in Fuerth

right in keeping with U.S. designs.

It must be remembered that the American continent is about the only place where the a.c. supply is 117 volts, 60 cps. In all of Europe and much of the rest of the world the standard line voltage is 220 or 250, at a frequency of 50 cps. Thus European-made products must be made in two forms if it is planned to export to the U.S. Sometimes one wonders if all the rest of the world is in step and we are out. Consequently, as most readers will have noted, it is common to provide a switch for different line voltages. The difference in frequency is not of much importance for electronic equipment—in fact, the advantage is with the 60-cps user, since 50-cps transformers should have more iron in them. However, with turntables, record changers, and tape recorders, it is necessary to provide different motor spindles to obtain correct speeds.

Metz' principal output is in television sets, with the percentage running about 80, and about 60 per cent of that is exported. The company is not large, when compared to a few of the others in Germany, or to the giants here in the U.S. It employs nearly 2000 people, however, and its sales are close to $20 million per year.

In addition to radio, TV, and electronic flash equipment, the company produces a line of transmitters and receivers for radio control applications, with some quite sophisticated transmitters designed with several tone-modulation frequencies. We could easily think up a few interesting things to operate with such a transmitter.

The main factory is located in Fuerth, and houses general offices, research and development facilities, and the electronic assembly lines. A second plant in Fuerth produces the cabinets used in both hi fi and TV sets.

The preponderance of television set manufacturing is understandable when it is considered that with its population of 57 million, there are nearly 7 million TV sets in use, and that from 15 to 20 per cent of the country does not yet have TV coverage, although that figure is gradually being reduced.

Radio and television in Germany is basically a government monopoly. Each of the eight "states" has its own radio facility, as well as TV, and these different production centers combine to produce nation-wide programs in addition to providing purely local ones. In only a few areas is it possible to receive more than one program on TV. Both radio and TV are supported by tax on receiving sets and by advertising, though the advertising is of a different nature than that to which we are accustomed. Commercials on TV are usually limited to one or two 15-minute periods per day, and only in certain areas does one hear, on radio, one record followed by one or more commercials as is common in AM practice here, and then for limited periods only.

There are some 40 TV transmitters of relatively high power, but there are dozens of others of low power covering areas which cannot receive the bigger ones. In addition, there are numerous small "frequency-changer" transmitters which seem to be equivalent to our hill-top relay stations which serve small secluded localities. It is likely that all of Germany will have television by 1966, and is thought by some that color TV will be introduced by 1967.

The practice of pooling the program-producing facilities extends also to radio. Each of the separate radio organizations produces programs primarily slanted to its own area, and all of the material seems to be made available throughout the entire country, though not necessarily on a network basis. A program heard in Bavaria on Monday evenings might be heard in Hamburg on Thursday, for example. Certain local programs are heard only in the area of production, but the magnitude of producing a complete schedule of programming in each area would be too great.

It must be remembered that while all of the German people speak German, there is a very considerable difference throughout the country in dialects, as well as in the local cultural background, much like it was in early days of radio in the U.S. What may be of interest to a resident of Munich may not appeal to his countryman in Frankfurt, for example. This was the case in the U.S. 30 years ago, but with the prevalence of network radio and television, the area preferences are no longer so marked.

Since the large radio manufacturers have of necessity been forced into making multiplex stereo tuners and radio sets inorder to meet the demands of the export market, there has been some pressure by them to have stereo adopted for the domestic trade in order to offer them a greater market at home. There are still relatively few stereo stations so far, but, as in the U.S., as the demand grows, the switch to stereo will surely follow. At present, it is estimated that about one-fifth of the country can now receive multiplex stereo.

In addition to the German programs, there is a fairly large network of stations, both AM and FM, throughout the country that are operated by the U.S. Air Force. Almost exclusively, Armed Services personnel and their families listen to these stations although they also have a large German following because of the popular music programs. But for the serious music listener, the variety available from German stations is superb. Operational techniques often seem unusual to an American, with occasional



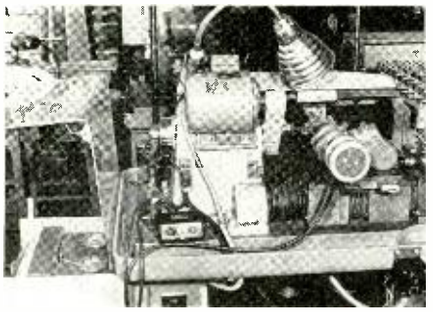
Left, Metz cabinet factory in Fuerth, and below, main plant of Uher in Munich as it was nearing completion



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Uher Royal Stereo 8000



Tape controlled machine making parts for the 5000 Universal. Tape is being reproduced from the 5000 model shown at the lower left corner



The Uher 5000 Universal—a tape recorder of considerable versatility

shifts from the most serious music to the opposite without any apparent reason or "bridge."

UHER

Leaving Fuerth on a Saturday afternoon, we journeyed the 100-odd miles to Munich through rolling country primarily devoted to raising hops—a likely enterprise since Munich is thoroughly established as a center of the beer country—Bavaria being long noted for its many fine beers and its myriad beer drinkers.

On the outskirts of Munich is located the main plant of Uher-Werke München, a company founded in 1953 by Count Toerring and his younger brother, who still are its owners. The company is under the managing directorship of Baron von Hornstein, and it is because of him that the entire output of Uher is devoted to tape recorders and their accessories.

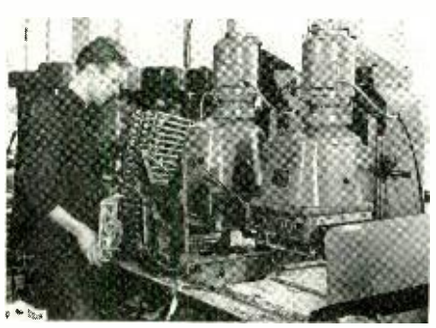
The main plant consists of four floors and basement, with most machining operations and all electronic assembly being carried out in the one building. The plant is quite new—so new, in fact, that the streets surrounding it are still in a state of construction. Because it is in the outskirts of the city, and because comparatively little housing is available in the immediate vicinity—which means that many of the workers come from quite a distance—the company operates a commissary so that workers obtain groceries and such items to tide them over when they can not get home early enough to do their shopping in neighborhood stores. In addition, an in-plant cafeteria provides hot meals for those who prefer not to carry lunches.

A second plant, built in 1960, is the source for sub-assembly items. Plastic moulding and major metal work is obtained from other factories in the vicinity.

While we are sufficiently familiar with machine tools, we were surprised to see multiple spindle drilling and tapping machines preparing the chassis for the various models of recorders in the line. One machine, for example, was busily turning out parts for the Model 5000 Universal, and its actions were programmed on tape for the precision grinding operation. What seemed most outstanding to us was the fact that the tape was being "played" on a 5000 Universal, so we actually have a machine engaged in turning out more of itself. Those concerned by the socio-economic aspects of this can be reassured, however, for one worker was constantly busy loading new parts into the machine and removing them after they had achieved their precise dimensions.

Currently the company employs some 800 workers. These people turn out a daily production of 550 recorders, representing, at the average factory price of $100, an annual output of over $15 million. All this comes from a plant occupying about 68,000 square feet, including administration and accounting.

Although the product line should be fairly well known in the U.S., we shall list them again, starting with the most elaborate model, the Royal 8000—a fully transistorized four-speed stereo machine capable of practically any type of operation desired by the user; the 4000 Report-S, a four-speed portable operating from a variety of battery supplies or from a.c. with a power unit, and of a quality suitable for broadcast applications and versatile enough to serve as a student's lecture recorder or a dictating machine; the Universal 5000, a transistorized, three-speed mono machine with a wide variety of automatic features such as continuous repeat, push-pull power stage, hand- and foot-operated remote controls, automatic volume control for dictation, and equipped with facilities for connection to an Akustomat accessory for voice-actuated operation, or to a Dia-Pilot so as to operate an automatic slide projector from a pre-cued tape. In addition to these, there is a wide line of simpler mono and stereo machines for their domestic market—models which are not available in the U.S.—and a



Multiple-spindle drilling machines—each drills 32 holes at one time on Uher 4000 Report-S recorder chassis



Assembly production line for Uher 4000 Report-S



Putting the finishing touches on a Uher 4000 Report-S

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Interviewees at the Press Conference—l. to r., Export Manager Herbert M. Wendt, Managing Director Baron von Hornstein, Uher distributor for the U.S. David Krechman, and the author



Section of the Braun plant at Frankfurt, where hi-fi products, radios, and loudspeaker systems are made. Other plants account for shavers, kitchen equipment, fans, movie cameras

new deck model which has not yet been shown in the U.S.

In addition to being our host in Munich, Uher was also host at a press meeting at which the writer and David Krechman of Martel Electronics, U. S. distributor of Uher products, together with Baron von Hornstein and export sales manager, Herbert M. Wendt had the pleasure of talking with representatives of the German newspapers and the wire services. For these two gentlemen, it was simple—they were fluent in German. The two of us from the U.S. were of necessity forced to deliver our talks and answer questions through an interpreter, no less than the Baron himself. An experience, to be sure, but at least one of the papers carried our picture and some of our comments. Some day we shall try to find out what the paper said we said.

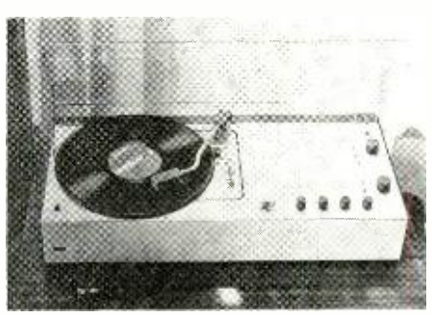
Like all good things, however, our visit to Munich concluded with our trip through the factory, but not until we had an opportunity to discuss some technical details with the chief engineer, thereby adding to our familiarity with the Uher products.

Leaving Munich around noon, again via Lufthansa, we arrived at the next city on our schedule—Frankfurt—were met by two new hosts representing Braun, A.G., escorted to a hotel, fed properly, and led to their plant.

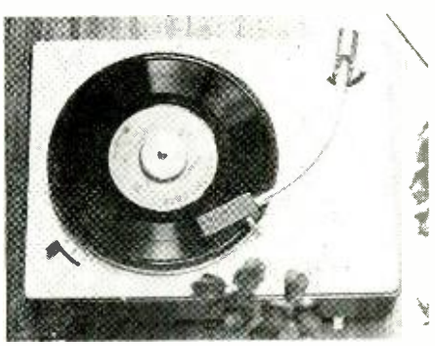
BRAUN, A.G.

Anyone would be impressed by the wide line of products manufactured by this group of companies, which includes eleven in Germany, eight throughout Europe, two in North America, and one in Japan. One only needs to see a simple listing of these products, or to see them actually in the Braun showroom located a stone's throw from the new music center in downtown Frankfurt. The line includes a number of electric shavers, a complete range of small kitchen appliances, fans and air heating devices, home and portable radios, stereo hi-fi systems, phono turntables and complete phonographs, a selection of loudspeaker systems, photoflash equipment, slide projectors, and several 8-mm movie cameras. All bear the Braun name except the cameras, which are called Nizo, after the Braun subsidiary which makes them in Munich, Niezoldi & Krämer, GmbH. Even if the Braun name did not appear on the products themselves, it is likely that anyone could recognize them from their similarity of design—a design, however, which has won more than fifty prizes in trade fairs and exhibitions all over the world.

This design theme is primarily functional above all else—there is never any ornamentation placed on the devices purely for the sake of ornamentation. At first viewing, one is inclined to think that the appearance is unduly "severe," since there are few curves except where they are a part of the function. One other similarity is in color—most devices are in varying shades of gray ranging from just off white to nearly black. We cannot testify as to the performance of the kitchen equipment (except for a percolator) but the photoflash units must be good since they are the ones sold in the U.S. by E. Leitz as companions to the Leica. We can testify to the sound quality of the hi-fi gear, however, having had a long demonstration privately for about two hours one afternoon and with a studio audience for another two hours during an evening concert given weekly in the demonstration studio of the company's principal Frankfurt dealer. These concerts are given every Monday evening for dealers, dealers' customers, and other interested music lovers, and are under the direction of Dieter Skerutsch of the press staff of Braun. He is also the author of a wonderfully instructive booklet circulated by the company—"An Introduction to Stereo High Fidelity"—one which we would like to see reprinted by our High Fidelity Institute. They'd probably want to eliminate the Braun catalog which is part of it. (Much of the interest the company has in hi fi undoubtedly stems from the fact that the president of the Deutches High Fidelity Institute is a Braun executive, Mr. Manfred Walter, who was our host in Frankfurt.) We would also recommend the weekly concert idea to U.S. companies as a means of developing interest in hi fi. Each week from 50 to 70 people attend the concerts and in addition to the music, they also get some pointers on hi fi —Braun-slanted, of course, but still good propaganda for high fidelity.

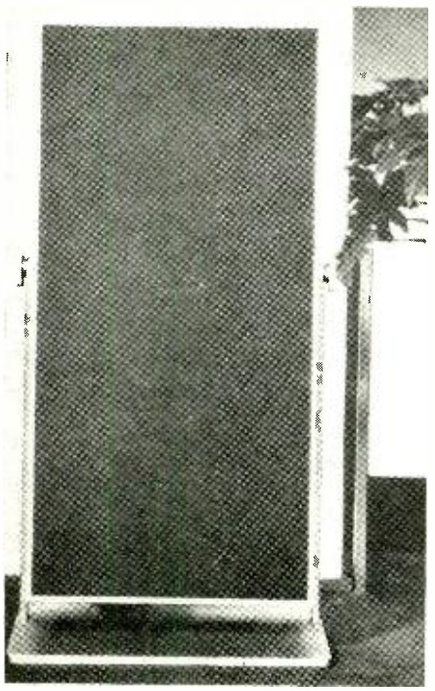


Braun "audio 1" incorporates long wave, broadcast, and short wave bands as well as FM and phono, and has plexi-glass lid



Braun PS 2 Stereo record player, compact 3-speed model for use with external amplifier

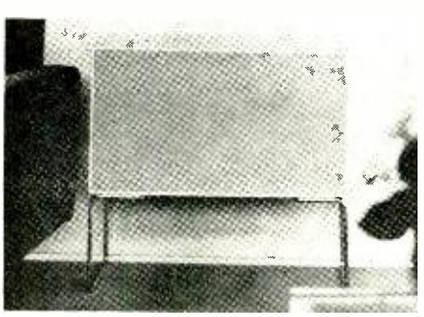
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Braun L 80 Hi-Fi and Studio Speaker System. Unit is 35 in. high, 17 in. wide, and is mounted on cast aluminum base with steel supporting arms permitting tilting of entire unit. Employs Leak "sandwich" woofer, mid-range cone, Kelly ribbon tweeter, and gives superb reproduction

The original founder of the Braun complex of companies was Max Braun, locksmith-cum-engineer-cum radio manufacturer. Among his innovations in the young market was the combination of radio and record player in one instrument. After usual wartime complications, the company was re-established after the war through difficulty but the strain was too much for Max Braun's heart. He died in 1951, and his two sons carried on.

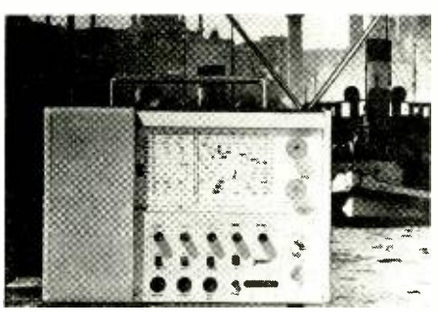
The company now has eight plants, employs over 4000 workers, and is in many ways a modern type of employer. The plants are equipped with gymnasiums, infirmaries, and employee lunchrooms—one innovation being the diet kitchens where well balanced meals of lighter types than the usual German fare can be had. We lunched there once and enjoyed a welcome respite from some of the heavy lunches which many of our hosts seemed to feel we would expect. We made up for it later, when Mr. Walter introduced us to some of Frankfurt's more typical culinary specialties.



Braun L50 and L60 speaker systems, which differ only in addition of a third tweeter in the L60. Note simple lines, practical steel-tube stand

In addition to the cafeterias in the plant, the company has a highly successful apprentice program from which they draw trained workers. Besides their own products in the hi fi market, Braun is also the distributor in Germany of Shure Brothers' products, and their phono equipment naturally uses Shure cartridges. The hi fi products manufactured by Braun include record players (for which they also make the turntables), amplifiers, tuners, and loudspeaker systems. The latter are assembled in the Braun plant from speaker mechanisms of several other companies. Braun believes that their share of the hi fi market in Germany is from 30 to 35 per cent; of radios, 3 to 4 per cent.

One custom of Braun which we have never seen anywhere else with respect to hi fi amplifiers is to include machine-run response curves with each one—one showing the "flat" response, and another showing the effect of phono equalization and tone-control performance. It is not unusual, for example, for curves to be furnished with high-quality microphones, but we do not know of any other manufacturer who furnishes individual curves on amplifiers.



Braun T-1000 All-Purpose receiver works on self-contained batteries, with power packs from 6, 12, or 24 volts d.c. or 110–220 a.c., covers long-wave bands from 130 to 420 kc, broadcast band, and from 1.6 mc to 30 mc, as well as on FM from 87 to 108 mc. FM limits on 1 μv signals

The company's sales in hi fi are in the vicinity of $2.5 million, about half of that being exported. Including all the company's products, total sales reach nearly $30 million. We have not seen much Braun hi fi equipment in the U.S., although it has been sold sporadically, principally by small importers. With the establishment of Braun Electric America, Inc. based in Toledo, O., we are likely to see more activity in this interesting line.

Since we finished our visits at Braun on Friday, May 15, we had a long weekend ahead, considering that Monday the 18th was a holiday throughout Germany. Thus we chose to travel to our next stop on the Monday. The destination was to be St. Georgen in the Black Forest section. The only way one could get to St. Georgen by air would involve the use of either a parachute or a helicopter. The first being impractical and the second unavailable, we took the train for the four-hour trip.

German trains are comfortable, fast, and efficiently run. When the second hand on the station clocks passes the 60 on the dial, the train due to leave at that particular time actually starts moving, and if you are due to arrive at 3:35, you can safely set your watch when the train stops at your destination. Our only complaint was the lack of screens on the windows to prevent hats being blown out. But this was not too serious a problem, since it was getting warmer, and it was an old hat, anyway.

From Frankfurt to St. Georgen is a trip full of variety—for the first half of the journey we passed through miles of rich-looking farm land and a number of picturesque cities. After leaving Karlsruhe (Elev., 500 ft.) it became an entirely new country, the train rising and twisting through the mountainous Black Forest country to St. Georgen with its elevation of 3000 feet, and passing through some 38 tunnels on the way. We arrived on that holiday afternoon, found a helpful taxi driver who knew where our hotel was, settled in, and unpacked. The next step was to explore St. Georgen, so off we went, on foot. Three or four blocks in one direction and we were out of town. Retracing our steps and starting off in another direction again led us out of town in a few blocks. One more try and we gave up for good, stopping into a likely looking place for tea. Thence back to our hotel (where, incidentally, no one but us spoke English—St. Georgen gets few tourists).

The next morning we were sent a car by our St. Georgen host company—Perpetuum Ebner—and after the usual formalities we encountered export director, F. Burkhardt and engineer H. G. Hagenah.

PERPETUUM EBNER

Fabrik fur Feinmechanik und Electrotechnik, Steidinger & Co., K.G.

So says their letterhead, but actually the first sight that greeted our eyes in St. Georgen was a factory with the trademark PE on its tallest building.

Founded in 1911 by Josef Steidinger who came from a background of watchmaking machinery, the company soon turned to the manufacture of spring-

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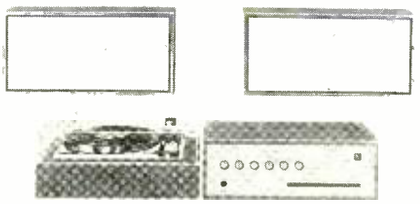
powered phono turntables. Albert Ebner began making electric motors for turntables in 1919, and the two joined forces in 1936. Improvements in manufacture, new products with genuine appeal, and a continuation of high-precision, high-quality products has led Perpetuum Ebner to its present annual output of around 500,000 record players, changers, and portable phonographs, both with and without amplifiers, which are sold throughout the world. The entire line includes low-priced models all the way up to the 33 Studio, a turntable designed for the serious hi fi enthusiast, having all the features desired for the user's convenience and satisfaction, such as automatic lowering of the pickup to the record, "preset" grooves in the arm assembly to locate proper set-down posi-



Perpetuum Ebner Model 34 Hi Fi record player

tion for 12-, 10-, and 7-inch records, vernier speed adjustment, push-button motor control which lifts the idler away from the motor shaft in the off position, built-in stroboscope, automatic lift-off of arm, at finish of record, which may be disabled at will, combination belt and idler drive, four-pole motor, cartridge mounted on a slip-out slide, counterbalanced arm, adjustable stylus force from ½ to 6 grams.

In addition to this de luxe model, PE also makes a complete range of turntables and record changers, some in carrying cases with amplifier and speaker, some in carrying cases with amplifier only, and some simply in carrying cases for use with external amplifiers and speaker systems. Furthermore, the company makes amplifiers and speaker systems. The over-all output of changers is around 1000 per day, with an additional 600 players filling out the day's work. Every motor used is made in the factory, with automatic punch presses stamping out the laminations and counting the stacks automatically. All sheet metal parts are stamped out right in the plant. Each motor is dynamically and statically balanced before assembly into the machines, and after completion the wow and flutter are measured automatically in several frequency ranges, such as 0 to 1000 cps,



Perpetuum Ebner Studio 60 stereo system, with amplifier and speakers

4–10 cps, 4–25 cps, 10 to 100 cps, and so on. 40 per cent of labor cost is for inspection. Typical assembly time for a changer is 12 minutes. The company employs some 900 workers, but with the completion of an addition to the factory, more will be needed.

Following a day in the PE plant, we spent the evening discussing a wide range of technical audio subjects with engineer Hagenah, a common practice with audio people throughout the world, we have noted.

The Black Forest area is full of manufacturing plants, most of them not large, but covering a wide range of products—particularly machinery for watch and clock making, and watches and clocks. Villingen, the largest town in the area, is the home of Saba, a large radio and tape recorder manufacturer. This town has a population of some 35,000, and is the home of Rambold precision measuring apparatus, and of Electro-Isolierwerke, a manufacturer of coaxial cables, and of Kienzle recording speedometers, as well as a number of other plants. Triberg, not far away, is the home of the famous Schatz clocks. St. Georgen itself, with a population of only 11,000, is also the home of Papst motors, familiar to most audio fans for their use in turntables and tape recorders where the use of hysteresis-synchronous motors is often considered important because of their absolute speed accuracy. It is also the home of Dual, well known in the U.S. as a fine record changer/automatic turntable.

On the morning of our second day in St. Georgen, the writer started out bright and early—well, perhaps not either, since it was 8:30, which is still early for us, and since it was raining slightly. On the six-block journey to Dual, we passed the Papst plant, and finally wound up at our destination.

DUAL

In this instance, the product is "Dual"—the company name is "Gebrüder Steidinger." The company was founded in 1900 by Christian Steidinger and his brother Josef. It must be remembered



Perpetuum Ebner's finest turntable—the 33 Studio

that in those days there were many "manufacturing establishments" throughout the Black Forest which were really only workshops in homes—originally starting as contracted homework operations, but expanding to two or three or more individuals, and usually including relatives, all working in the home shop of one of them. Naturally the more enterprising developed into regular factories, and many high-quality precision machinery companies owe their origin to such humble beginnings.

The name "Dual" comes from a phono turntable built in 1927 with the unique powering of both a spring motor and an electric one—hence dual-powered. They made 2000 of these a day, exporting as far as Russia. The "archives" room at Dual houses at least one of each of the company's products in the phonograph turntable line since its beginning—a veritable museum of the phonograph. Adjacent to this museum is a modern display room with all the current models—a far cry from some of the first. The top lines of Dual are manufactured at St. Georgen, record players at a second factory in Dunninhen, and tape recorders are built under

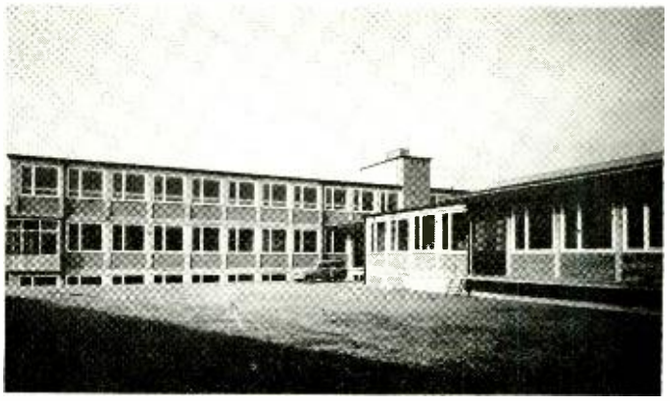


View of part of St. Georgen in the Black Forest

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Left, Dual's main plant, St. Georgen, and below, the plant at Messkirch



contract at Lahr, with the die-casting tools being owned by Dual.

A trip through the St. Georgen plant shows the visitor a wide range of manufacturing and inspection processes. Even as simple a part as a motor rotor gets all the attention one might expect for a watch, and the balancing procedure itself is of interest. The inspector puts the rotor into a fixture and starts it turning. The indication is on a screen similar to a scope, with a dot of light indicating where the extra weight is, and the deflection from the center of the screen indicating the magnitude of the unbalance. The worker then removes the rotor from the fixture and drills a hole in the rim at the indicated point to a depth proportional to the unbalanced weight. What is amazing is the operator's ability to "guess" the depth to which he should drill the hole to correct the unbalance. Another check on the machine usually shows that the unbalance has been reduced to about one eighth of what it was at first, so another drilling is indicated, much shallower this time, and a final check shows a rotor to be in balance.

After assembly, every changer is given an eight-hour break-in run before final tests for wow and flutter—just as rigorous and careful as the balancing procedure described.

For such a "simple" device as a record changer, it is most interesting to see the engineering and development work going on continually in the constant search for perfection, and one wonders how there can be a market for so many phonographs.

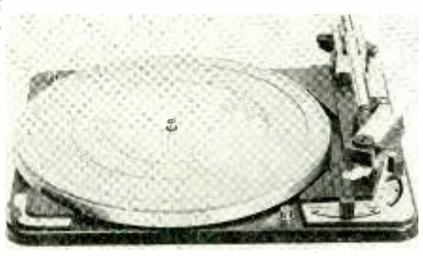
With their 1600 employees, and with approximately 40 apprentices in training at all times, the company now turns out over 600 changers and 1000 record players every day in the four plants. Aside from plastic molding, practically everything is built in the company's plants, and from 35 to 40 per cent of the output is exported.

The company is still under the direction of Steidingers, with Oskar as Managing Director and Siegfried as head of production. Dual products are distributed in the U. S. by United Audio Products.

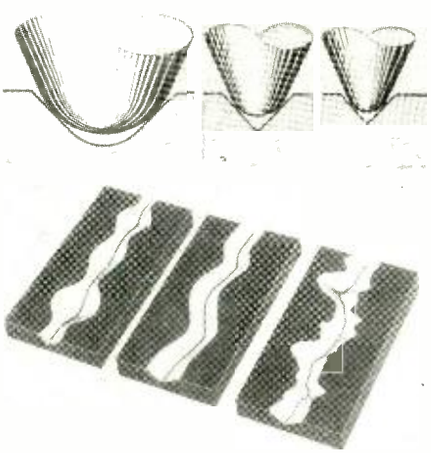
We are considerably impressed with some of the literature produced by the German companies. These items, partially catalogs and partially informative, are liberally illustrated with diagrams which we suspect we shall "borrow" at times in the future to illustrate a point. In German, they make for slow reading, but if translated they would be equally acceptable here—or anywhere. The descriptions of phonograph records, grooves, and the action of stereo recording and playback in Dual literature are masterpieces.



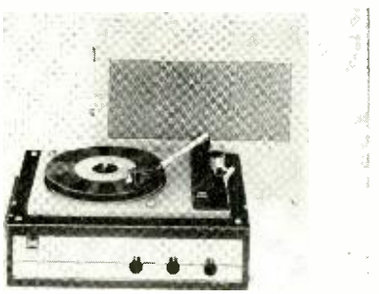
Dual 1009 Automatic turntable/changer



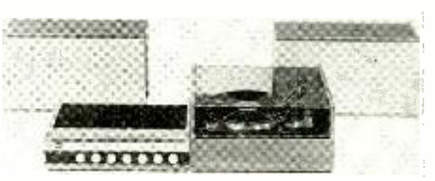
New Dual model 1010 auto turntable/changer



Samples of technical illustrations in Dual instruction book on high fidelity. Top figure shows relative dimensions of standard groove and stylus, microgroove, and stereo. Lower figure shows, from left to right, vertical or hill-and-dale record groove, lateral, and stereo

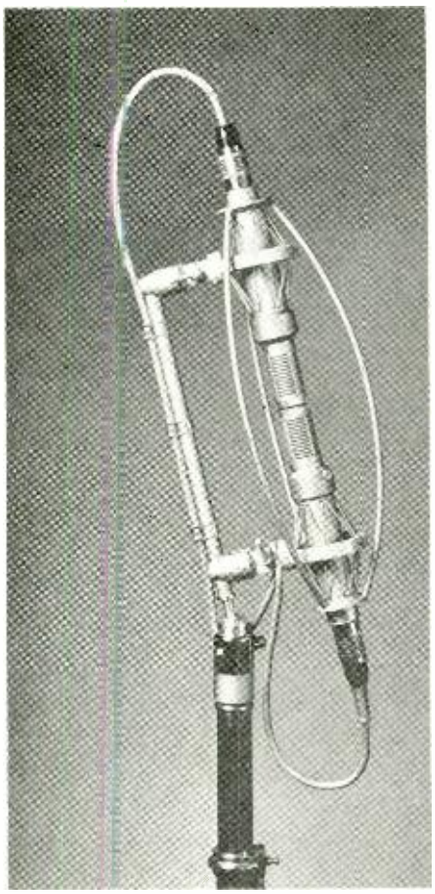


Dual Party 400 V portable mono system



Dual stereo system, with amplifier and speakers

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Stereo mounting of two Schoeps variable-pattern condenser microphones

Two days in the Black Forest are not enough, but like all good things, this visit had to come to a close, and the next stop was to be Karlsruhe, the home of Schoeps microphones.

SCHOEPS

This line of microphones, sold in the U.S. by International Electroacoustics, Inc., is known by the name of the designer, Dr. Karl Schoeps, though the name of the company is Schalltechnik —sound technique. Located in Durlach, a suburb of Karlsruhe, this is one of the plants we did not actually visit, although we did spend a few hours with Dr. Schoeps and learned something of the product and of his company.

Founded in 1948, this company has been devoted exclusively to the development of condenser microphone systems and accessories. Over the past 16 years the company has continued to grow until its present factory facilities are strained to the limit. Plans are now under consideration for the construction of a new facility of more than twice the size of the present plant. One of the contributing factors to the company's growth was the acceptance of the French radio and television systems of the Schoeps units as meeting the high quality standards of RTF (Radio-diffusion-Television Francaise) for smoothness of frequency-response and for low distortion. The standards branch of the German IRT (Institut für Rundfunktechnik) has also given its approval to Schoeps microphones and has accepted them as standard.

These microphones have also been included in the catalog of products by such firms as Siemens & Halske and Telefunken, and hundreds have been sold here in the U.S. with the latter trademark. About 40 per cent of the Schoeps output is consumed domestically, with the remaining 60 per cent exported. All products in the line were developed in the company's own laboratory, and fundamental research which has led to the acquisition of over 20 patents is also done in the same self-contained laboratory facilities. Also, all production is virtually complete within the factory, including all machine work, electroplating, mold making, transformer winding, and plastic injection molding.

A unique feature of Schoeps condenser microphones is the method of capsule construction. All models, including those with multiple-pattern switching, are constructed with a single metal diaphragm—the various directional patterns being achieved by altering the acoustic chambers behind and around the diaphragm. This patented construction gives a smooth high-frequency response and a higher front-to-back discrimination in the cardioid pattern than is possible with any double-diaphragm system, it is claimed. Each capsule is individually tuned in production to ensure uniformity.



Schoeps condenser microphone body with four types of capsules for different patterns

In addition to the conventional tube-type models, the company also makes transistorized radio-frequency models, all using the same capsules which are available in omni-directional, cardioid, two-pattern, and three-pattern models. The two-pattern microphone capsules provide both omni-directional and cardioid patterns, and the three-pattern models offer in addition the figure-eight distribution.



Sennheiser MD212 Lavalier Microphone

The transistorized models can operate from a variety of voltage sources—central battery, local battery, or a.c. supply.

Following our visit with Dr. Schoeps, we next resorted to the train bound for Hanover for the second time. With the Messe over, finding a hotel at midnight was relatively simple.

SENNHEISER

The following morning we located one of the few English-speaking taxi drivers in Hanover—almost certainly the only English-speaking *lady* cab driver—and $7.50 later we finally arrived at the Sennheiser plant in Bissendorf, a delightful place reminiscent of a country club. It occupies several buildings, with the main one shaped like a squared-off hand, with the four fingers representing separate departments, each of them having outside windows on two sides. Because of the nature of the work, the entire plant is air conditioned to ensure cleanliness. Modern and equipped with precision machine tools, as would be expected in a plant engaged in making microphones, it was equally well equipped with test and measuring instruments. As a matter of fact, it seemed that everywhere one looked there was another Bruhl & Kjaer automatic audio curve tracer. When it is remembered that these instruments are readily obtainable at more than $3000 each, it is obvious that one cannot start making microphones on a shoestring. Not only do they make microphones, but also amplifiers, and a number of test instruments—one a superb impedance meter—wireless microphone transmitters and receivers, and a line of low-level transformers.

The range of microphones includes some about the size of a sugar cube for hearing aid use, a line of models typical of those which accompany ordinary low-priced tape recorders, and a dozen or so high-quality dynamic types suitable for broadcast use. At the top of the line is a variety of condenser types with transistorized r.f. circuitry and thus requiring only a low operating voltage readily available from most portable tape recorders or from a battery-carry-

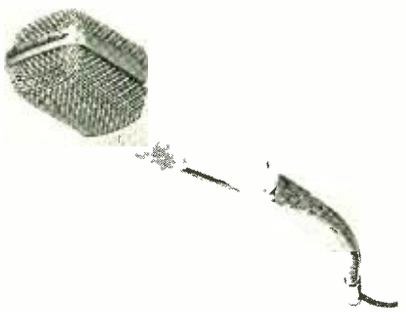
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Sennheiser MKH 104 transistorized r.f. condenser microphone with battery case and six mercury cells. Case mounts between microphone and cable

ing accessory little larger than the connecting cable plug. Many of the company's products appear on the market with other names on them, but the same rigorous inspection procedures are followed for every type.

The miniaturization of the transistorized r.f. circuitry is something to see. Imagine putting three transistors, four diodes, three transformers, and a number of resistors into a case measuring 13/16 inches in diameter and 5 inches long over-all, including the condenser



Sennheiser Model MD421 directional studio dynamic microphone

capsule—and this allows for the thickness of the tubing which constitutes the housing and still leaves room for the connecting plug. Aside from the development of the circuit and making it work properly under the ambient heat encountered near the lights of a TV or movie studio, there is the miniaturization to consider. But these microphones offer many advantages in professional applications, not the least of which is the elimination of the power supply which usually demands a polarizing voltage of around 90 volts in addition to the current for the heater of the cathode-follower tube generally used. The line includes miniature earphones which are similar in constructional techniques to microphones, and a number of accessories for use with them. There is also a 15-watt monophonic amplifier and a 20-watt stereo model.



Sennheiser Impedance meter Model ZP-2, with range from less than 1 ohm to 1 megohm, measuring at three frequencies

The ride back to Hanover, interrupted on the way for lunch, gave an opportunity for further exchanging of ideas with Professor Sennheiser—and saved a second $7.50. From Hanover by train was the next step toward reaching Kiel, the home of the Miracord. The last step was by car from Hamburg, a trip of about 60 miles.

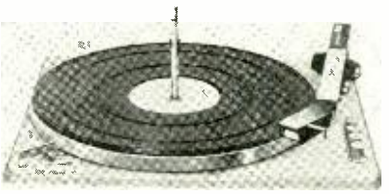
ELAC

Electroacustic GmbH is Elac's full name, though the name of the company's product—Miracord—is more familiar in the U.S. The Miracord is far from being the company's only product, however, since their nautical business represents about 40 per cent of the total. In the nautical products, the company makes underwater signaling equipment, fish finders, fog horns, and similar devices. The fog horns are little more than big loudspeakers, since they are designed for 1000 watts input power, and are 60 per cent efficient. It is not recommended, however, that any of the high-power audio fans order a pair for their stereo systems because they have a very limited frequency range—*one* frequency only, approximately 300 cps. These horns weigh 600 pounds each, and it is almost unbelievable that 300–400 a year are shipped to the Gulf of Mexico area *by air* for use around the offshore oil-drilling rigs.

In the hi fi field, the company's output is around 700 record changers and players per day—150 large changers, 350 small ones, and 200 manual players. Elac employs some 1400 people, expanded over the last 7 years from 1000, and 150 of these are apprentices in both technical and commercial divisions. The training takes 3½ years for the technical apprentices, and about 3 years for those training for the commercial end of the business.

The company was founded in 1926 by Dr. Hecht and Messrs. Schmidt and Rudolf, all formerly with Submarine Signal Company in the U.S. Mr. Schmidt, now 80 years young is the only one of the three surviving, and he comes to the plant every day. His son, Tjard G. A. Schmidt is now vice-president and general manager, and Mr. Rudolf's son is still with the company as production manager. Technical people in research and development number 75 to 80, and 10 engineers are assigned to the manufacturing division. Managing Director Wilrodt came to the company from the presidency of the general labor exchange in Dusseldorf in 1955. The director of technical research is Dr. Ahrens, who secured the original patents for the moving-magnet stereo pickup.

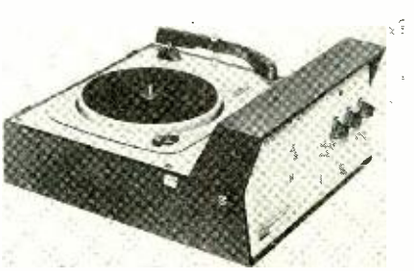
The record player and changer business was commenced in 1950, following a reopening of the factory after the war with consumer products, auto accessories, radios, and theatre loudspeakers. A few years later, the government permitted the company's re-entry into the nautical field.



Elac's familiar Miracord PW-10H automatic turntable

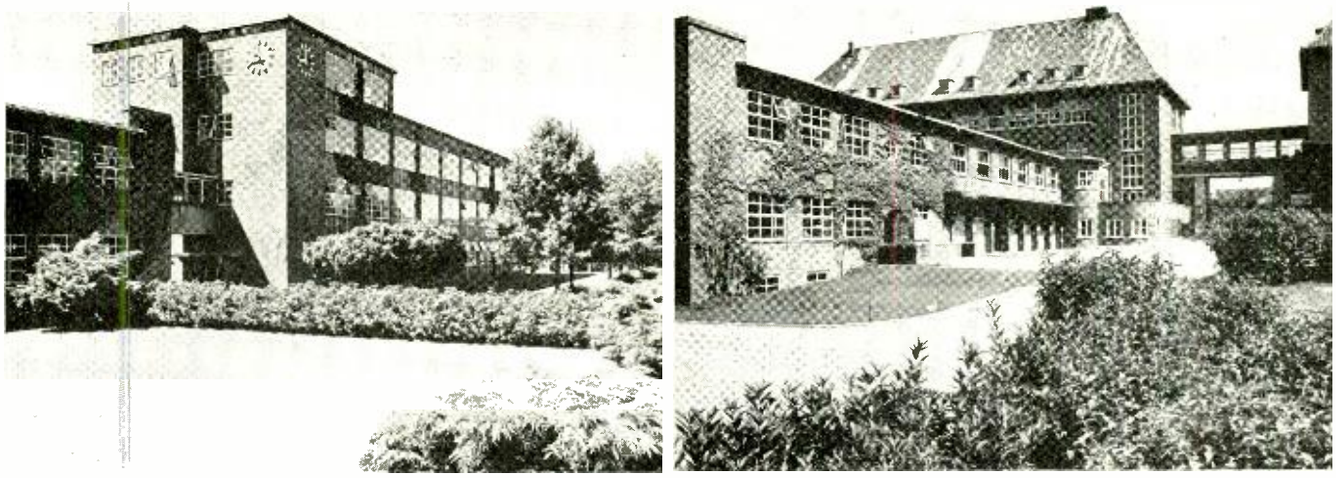
The present factory site was purchased in 1930 and the buildings erected over the following eight years. By government order, the plant was expanded to help in rebuilding the navy. The earlier prewar buildings were given over to a university, now adjacent to the plant. Actually, the entire main plant looks more like a university than a factory anyway, with its impression of solidity and permanance.

Kiel is an attractive city, and not in the usual pattern of tourist travel, which is unfortunate for the tourists. It is located on the harbor at the eastern end of the Kiel canal, in the most northerly part of West Germany. In addition to



Elac "Mirastar" S 1200V portable mono system

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Two views of main Elac plant at Kiel which show it to look more like a university than a factory

the main plant, another is used exclusively for the nautical products, and still another plant, for the manufacture of phono cartridges, is leased. Besides their own hi fi products, Elac is the distributor in West Germany for Fisher, and they have done a remarkable job, especially when one considers that a Fisher 800C, selling at about $450 here costs DM 2760 ($690 U.S.) which represents the salary of a good secretary *for six and a half months*. In addition to the familiar Miracord changers and players and the Elac phono cartridges, sold in the U.S. by Benjamin Electronic Sound Corp., the company also makes complete phono systems for their domestic market and for export other than to the U.S. Export business is about 50 per cent of the total, and about 15 per cent to the U. S. Several loudspeaker systems also bear the Elac name, the assembly being outside their plant on contract.

According to Elac, the development of hi fi in West Germany is slow because of a lack of dealers with enough knowledge of hi fi merchandising to do a good marketing job. They list only about 60 good dealers in the entire country who have sufficient interest in hi fi to push it properly. However, they are confident that it will become as popular there as it is in the U.S. today, though it may take another five years.



Elac "Mirastar" W 16 AV table monophonic system

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We wish *Hi Fi Stereophonie* the best —it takes a serious audio publication to get the hobby under way as vigorously as it is in the U.S. today—as we know all too well.

Two days in Kiel and we were on our way again—back to Hamburg in an automobile, and thence by plane to Berlin to try to see the Neumann plant. As our luck would have it, our contact there was on his vacation, so we sought their information later, and came up with these items.

NEUMANN

George Neumann Laboratorium für Electroakustik, GmbH, to use its full name, was founded in 1928 by Mr. Georg Neumann, who is president and owner. Executive vice-president G. Lützkendorf and sales and finance vice-president W. Weiss complete the management staff. The production of the company is concentrated highly on condenser microphones and disc-cutting lathes, with transistorized studio amplifiers a rapidly growing section of the firm's output over the last four years.

The company's head office, test laboratories, and principal manufacturing facilities are located in West Berlin with 180 employees. A branch factory in Heilbronn, in West Germany, employs 40 persons to supply pre-fabricated parts to the Berlin plant, as well as a line of electro-chemical stabilizing cells. The West Berlin factory occupies about 30,000 square feet, while the Heilbronn plant is about 5000 square feet in area.

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Neumann U 64 condenser microphone

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FOR AUDIO



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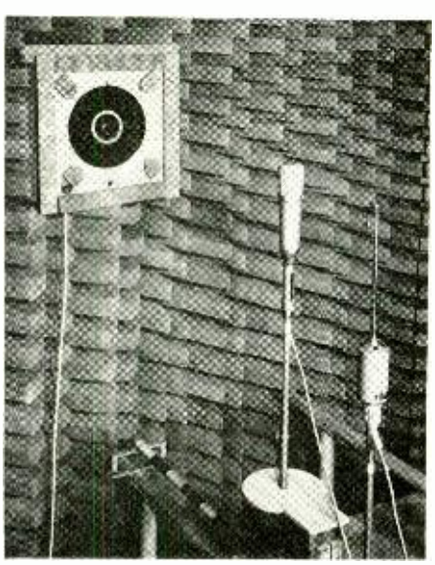
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Neumann measuring set-up, with MM 5u calibration microphone in foreground and U 67 in measuring position on turntable (nearest loudspeaker) in anechoic chamber

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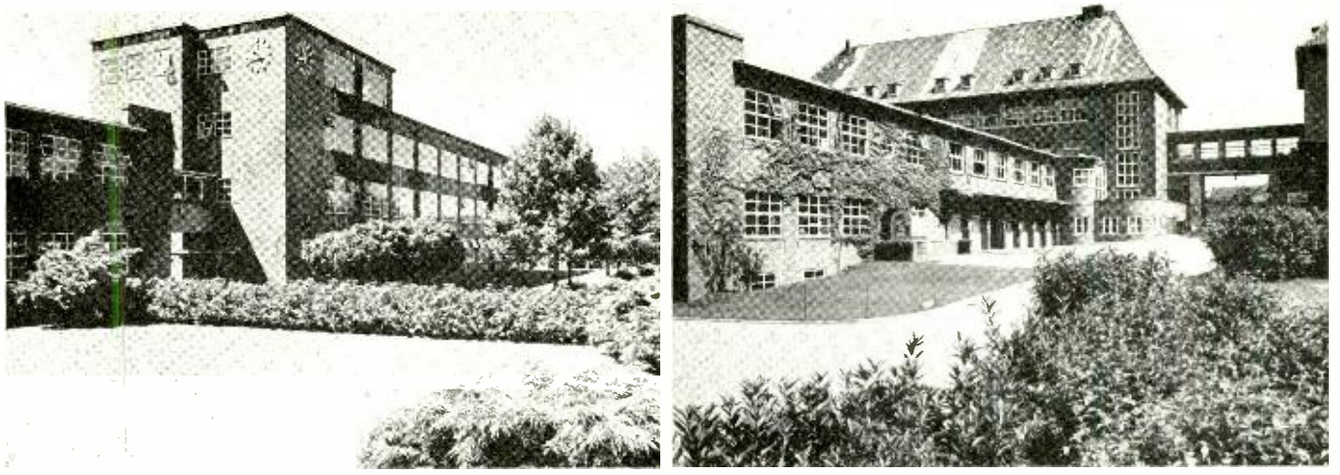
Transistorized control console by Neumann

Klein + Hummel's amplifiers and tuners and loudspeakers, which are legion. This company introduced a compact amplifier in 1954, a table-model amplifier with variable damping in 1955, a 40-watt table model in 1957, followed by many other innovations, including stereo amplifiers finally in 1963. It is a very attractive line in appearance, and we sincerely regret the scheduling of our trip, combined with a shortage of time, which caused us to miss Klein + Hummel. We shall hope for another opportunity to visit Germany when they shall be our first stop.

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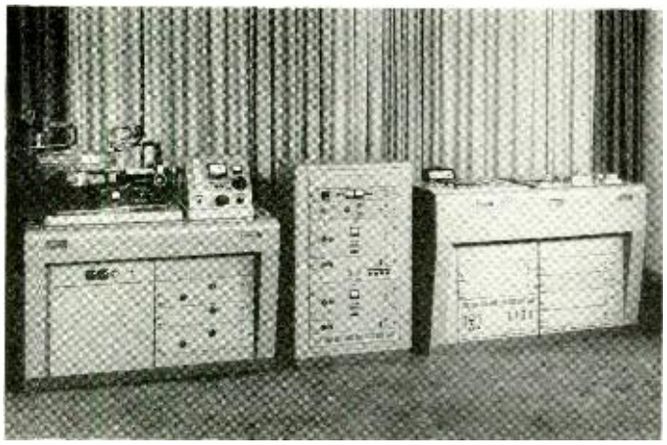
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Neumann U 64 condenser microphone

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Neumann disc recorder with accessories, at left, amplifier rack in center, and Telefunken studio tape recorder and amplifiers at right

microphones and the disc cutting lathes are well known throughout the world, with exports accounting for about 65 per cent of the total output.

The line of condenser microphones includes the well known U67, which fulfills electrical and acoustical requirements of the recording industry to a high degree. This model provides cardioid, omni-directional, and figure-8 patterns selectable by slide switches. Two condenser capsules are employed, mounted back-to-back, each with heat resistant polyester foil diaphragms, and the entire microphone can be disassembled without the use of tools, making for easy tube replacement in the field. Similar in appearance, but with continuously variable pattern control remote from the microphone is the Model 269. Models KM53a and KM54a are miniature microphones with omni-directional and cardioid patterns respectively. Models SM2 and SM23 are stereo models, differing primarily in power supply requirements and flexibility. For calibration-standard work, models MM3, MM5, MM3u, and MM5u are available.



Neumann measuring set-up, with MM 5u calibration microphone in foreground and U 67 in measuring position on turntable (nearest loudspeaker) in anechoic chamber

These units have a linear response over their entire frequency range, with the "3" models covering the range from 30 to 16,000 cps, and the "5" models from 20 to 40,000 cps. The models having the suffix "u" are equipped with a switch which reduces the signal from the capsule for use in high-pressure fields. Still other models complete the line.

In the area of disc cutting, Neumann has a wide variety of lathes, cutters, and associated equipment which is considered outstanding throughout the world. Also in the line is a truly professional playback turntable.

Another line of equipment which is primarily of professional interest consists of transistorized amplifiers for studio use, along with mixing panels, equalizers, equalizing amplifiers, and control facilities for recording and broadcast application.

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After leaving Germany, we made brief visits to Ortofon in Copenhagen, Luxor in Motala, Sweden, Tandberg in Oslo, Truvox in London, and Thorens in Switzerland, finally returning to Frankfurt for a brief stay—and the trip to Wetzlar described previously. We talked with some longtime AUDIO subscribers and a few new ones, including one audio specialist who had learned his trade from reading AUDIO during a seven-year enforced stay in a prison camp outside Germany. The last day arrived, and again we entrusted ourselves to Lufthansa for the trip home and our last taste of de luxe European travel service. The schedule called for departure from Frankfurt at 1:30 p.m. and arrival at New York at 5:00 the same afternoon, which was just what we did.



Transistorized control console by Neumann

In Retrospect

In our opinion, one of the greatest pleasures of traveling is that of looking back over the days spent away from home, and savoring anew the experiences of the trip—the people, the food, the new sights, and the customs. Too, there is regret at the things missed. To visit every audio and hi fi manufacturer in Germany would take at least six months. We are especially sorry not to have seen Beyer, with their line of headphones, microphones, and related equipment. And, of course, Telefunken, Bogen, Hirschmann, Daut, and others who make the bits and pieces that comprise the finished components.

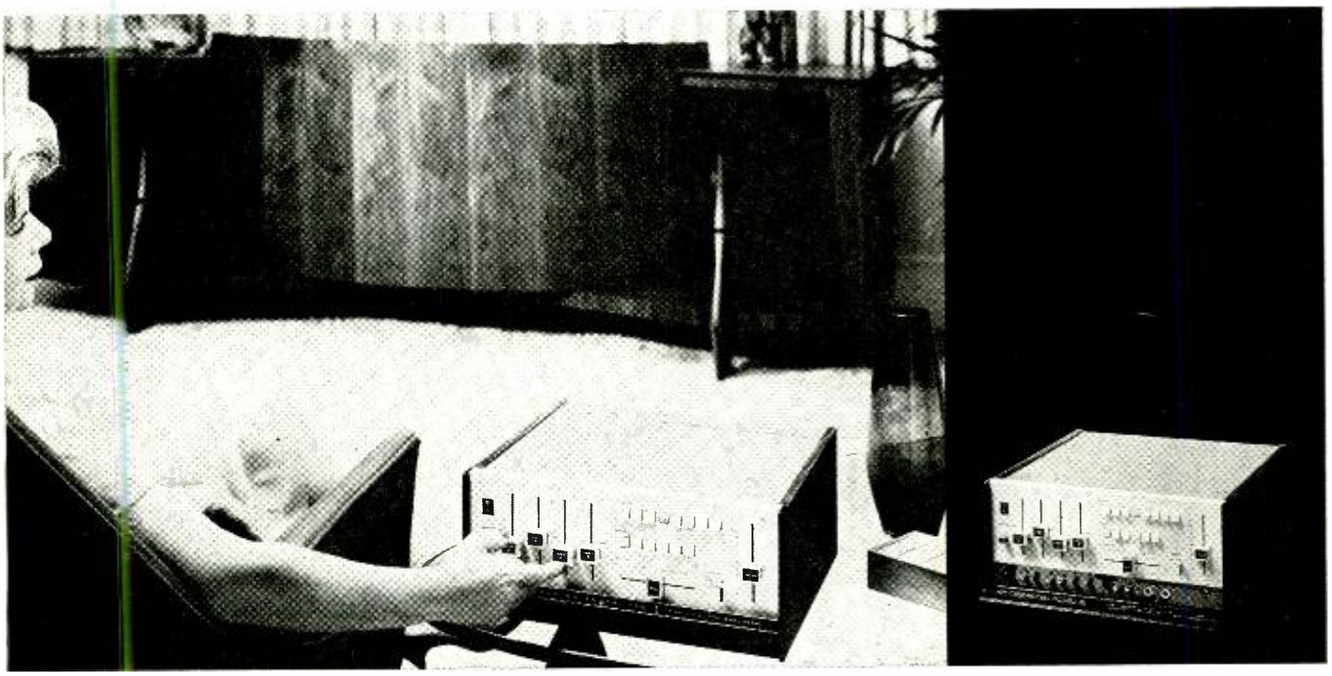
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The Energizer/Transducer in the background is the incomparable JBL Ranger-Paragon, an integrated stereophonic reproducer with power source matched perfectly to its professional loudspeakers. Signal is regulated by a solid-state stereophonic JBL Graphic Controller, a new component of such enduring excellence, incorporating so many desirable innovations that it became a classic the day it was introduced.
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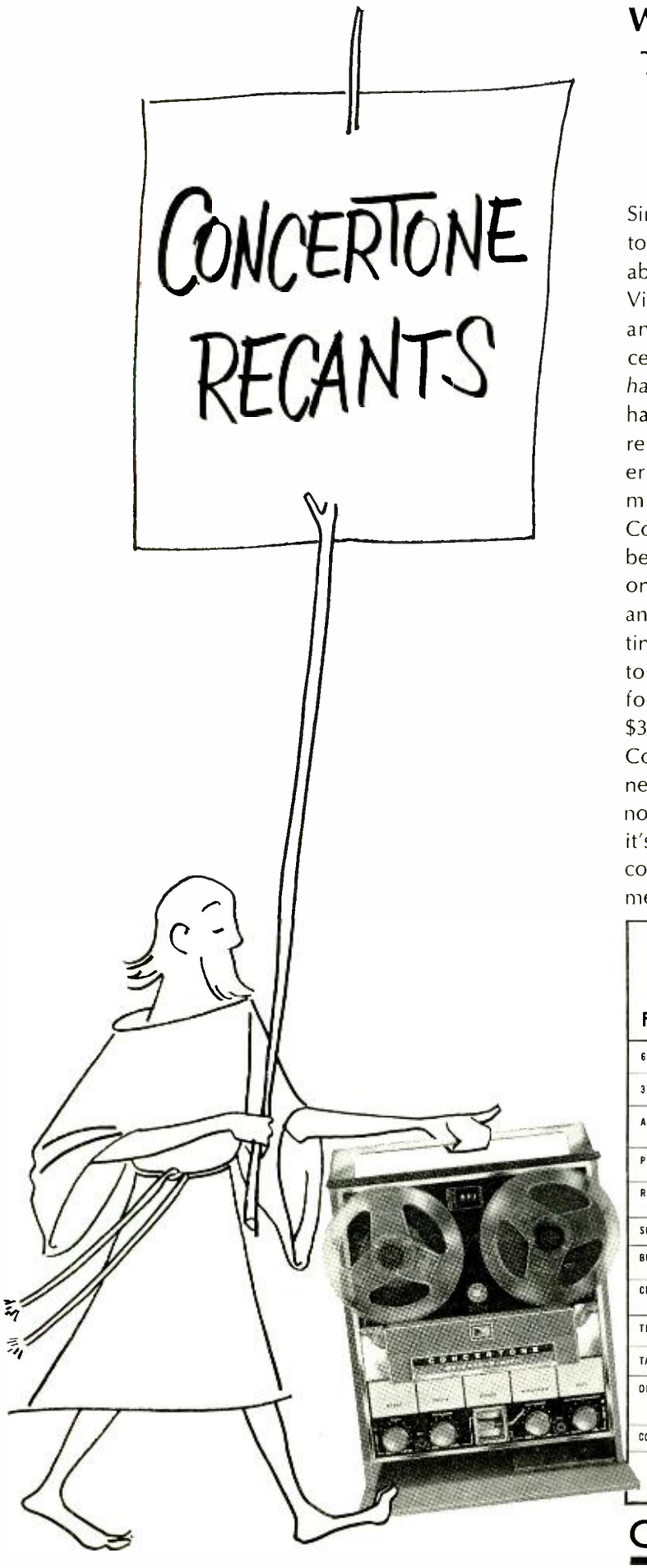
Inevitably, the person who is implacably determined to own the finest develops a staunch affinity for JBL components. He comes to realize that each component bearing the name JBL — whether it be a precision loudspeaker system, a self-powered loudspeaker, or Graphic Controller — has been perfected for just one purpose: to contribute a degree of excellence to the talented listener's high fidelity system that is not available from any other source. In fact, it has been observed that JBL makes components of such consummate quality that they are destined to become heirlooms, passed on from generation to generation like a treasured violin, priceless chronometer, or singular pianoforte. The JBL Customer Service Department is established for the purpose of guiding you to the achievement of verbatim music reproduction in your home, and to send you a free catalog together with the name of the Franchised JBL Audio Specialist in your community. Kindly address your inquiry to . . .

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WE DARED TO COMPARE THE CONCERTONE 800

and heard from our competitors

Since "an honest tale speeds best being plainly told," we would like to make a public apology about our first Feature Comparison Chart. The Viking 220 tape recorder *does have* tape lifters and transistors. The Freeman 200 *does have* center capstan drive. And, the Tandberg 64 *does have* remote control and tape lifters. Hence, we have amended our Chart accordingly and have reproduced it again. While contrite, because we erred originally, we feel that even with these minor adjustments you will still see that the Concertone 800 (portable or tape deck) is your best value in stereo tape recorders! Furthermore, only the Series 800 has double Reverse-o-matic® and six heads that combine to give you continuous music playback and recording with the touch of a button, without reel turnover. Prices for this incomparable device start as low as $379.95. If you're really interested, send for a Concertone brochure and the name of your nearest dealer. The brochure is flawless, with no accidentally erroneous comparisons. Besides, it's free and has a neat drawing of a bird on the cover. Write to Concertone, Repentance Department, Box 3162, South El Monte, California.

FEATURES:	AMPEX 2070	CONCERTONE 800	CONCORD 884	EICO RP-133 WIRED	FREEMAN 200	NORELCO 401	REVERE M-2	ROBERTS 800D	SONY 262	TANDBERG 64	V-M 740	WEBCOR EP-2360	VIKING 220
6 HEADS	No	Yes	No	No	No	No	No	No	No	No	No	No	No
3 MOTORS	No	Yes	Yes	No	Yes	No	No	Yes	No	No	No	No	Yes
AUTOMATIC REVERSING FOR RECORD & PLAY	No	Yes	No	No	No	No	No	No	No	No	No	No	No
PUSH BUTTON CONTROLS	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes
REMOTE CONTROLLABLE	No	Yes	No	No	No	Yes	No	Yes	No	Yes	No	No	Yes
SOUND ON SOUND	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BUILT-IN ECHO CONTROL	No	Yes	No	No	No	No	No	Yes	No	Yes	No	No	No
CENTER CAPSTAN DRIVE	No	Yes	No	No	Yes	No	No	No	No	No	No	No	No
TRANSISTORS	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	Yes
TAPE LIFTERS	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	No	Yes
OPERATES BOTH HORIZONTAL & VERTICAL	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	No	No	Yes
COSTS UNDER $400	No	Yes	No	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	No

CONCERTONE

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JAZZ and all that

Bertram Stanleigh



Miles Davis in Europe
Columbia Mono CL 2183

This is a live recording made at the 1963 Antibes International Festival at Juan-les-Pins in the south of France. George Coleman, tenor, Herbie Hancock, piano, Ron Carter, bass, and Tony Williams, drums, provide a well-matched group of collaborators for Davis who is in fine, hard driving form. The recording, made by the Radio Diffusion Television Francaise for broadcast purposes, is in most respects far superior to the usual run of live festival tapings. Audience noise is kept to the lowest practical level, and the closely miked instruments sound as full and rich as in a studio taping. Applause levels at the end of a solo never rise to a point where they completely obscure the work of the group, and the audience acclaim at the end of a selection never exceeds a scant ten seconds. Aside from a brief fifteen second announcement in French at the start of the disc, there are no verbal introductions, and the performers do not shout out any thank you's at the ends of numbers. One's attention is not distracted at any point during the playing, and this is as it should be for these are long, well worked out performances, surging with energy and ideas. Five tunes are played, *Autumn Leaves, Milestones, Joshua, All of You* and *Walkin'*. The shortest selection runs over nine minutes, the longest, over sixteen. This is sufficient time for an inspired musician to unburden himself of complex thoughts, and Miles has made good use of his opportunities.

Thelonius Monk: It's Monk's Time
Columbia Mono CL 2184

With the assistance of Charlie Rouse, tenor, Butch Warren, bass, and Ben Riley, drums, Monk offers a splendidly striding recital filled with extrovert, good humor and grounded on a solid technique. *Lulu's Back in Town, Stuffy Turkey, Brake's Sake,* and *Shuffle Boil* receive vigorous treatment from the quartet, and Monk contributes two solos, *Memories of You* and *Nice Work if You Can Get it*. The poise and assurance that are a hallmark of this musician's style come across with clarity in this recording which is notable for its fine balance and good piano sound.

Sonny Rollins: Now's the Time
RCA Victor Stereo LSP-2927

Bright, crisp versions of eight modern jazz standards are offered by Sonny Rollins with the alert and eager assistance of Herbie Hancock, piano, Ron Carter, Bass, and Roy McCurdy, drums, on Charlie Parker's *Now's the Time*, Benny Golson's *Round Midnight*, and John Lewis' *Afternoon in Paris*. Slightly altered forces, without piano, are employed on the remaining numbers, which include Rollins' own *St. Thomas*, Dizzy Gillespie's *Blue N' Boogie*, Golson's *I Remember Clifford*, Miles Davis' *Four* and Thelonius Monk's *Fifty-Second Street Theme*, which also makes use of Thad Jones on Trumpet. From start to finish, the show belongs to Rollins who delivers a series of highly polished solos and rarely steps aside to make room for statements by his collaborators. Much of the success of this new waxing is due to the remarkably fine sound contributed by RCA. Splendid stereo separation is matched by flawless cutting and some of the quietest record surfaces thus far encountered.

Oscar Peterson Trio + One, Clark Terry
Mercury Stereo SR 60975

The combination of Peterson and Terry is one of the happiest ideas ever to find its way onto wax. No two performers have ever done more for one another. The swinging stride of Peterson strikes fire to Terry whose usual work is more noted for contemplative profundity than for the fresh abandon he displays on the present platter. And Terry's abundant supply of ideas encourages Peterson, whose healthy rhythm and excellent technique are not always matched by first class inspiration, to probe more deeply and meaningfully. The results are happy music, filled with purpose, bright in sound and briskly swinging. The tunes include Peterson's *Blues for Smedley, Roundalay* and *Squeaky's Blue* and Terry's *Mumbles* and *Incoherent Blues*.

Dizzy Gillespie: Dizzy Goes Hollywood
Philips Stereo PHS 600-123

"And Dizzy has achieved in this album a feat that he has wanted to attempt for many years. To develop an approach to a popular melody that appeals not just to the jazz fan, but to everyone." According to the liner notes, that was Dizzy's purpose. He accomplishes his end with no particularly complicating problems, and we can all hope, that having gotten this particular desire out of his system, that he will return to matters more worthy of his imagination and technical prowess. Not that the present set isn't an agreeable group of tunes played with style and consummate technique, but we have reason to expect more than this from a man of Gillespie's stature. We anticipate a degree of close personal involvement between Diz and the music he plays that is wholly lacking in the present performance. It doesn't sound as if he's trying hard, neither does it sound as if he's kidding around, having fun. Indeed, what this platter sounds like is a project dreamed up by an A & R man and with which Dizzy has gone along simply because the tunes are pleasant enough, and he's a man who likes to make music, any kind of music. Will the resulting collection really please both the hipsters and the Alfred Newman devotees? I have my doubts. There's too much melody and too few ideas for the jazz fans, and I suspect that many of the lush music fanciers will find they have to work hard picking out their favorite melodies from "Cleopatra," "Walk on the Wild Side," "Mondo Cane," "Never on Sunday," etc. Two matters will win the admiration of all listeners, however, Dizzy's perfect control and Philip's admirable recording.

Ben Webster: See You at the Fair
Impulse Mono A-65

Assisted by two excellent pianists, Hank Jones and Roger Kellaway, Ben Webster offers nine performances that demonstrate his taste, vigor and the sensitive restraint in his exceptional music making. While the title tune, an original by Webster, and the jacket photograph, link this new release with the New York World's Fair, the balance of the platter consists of a group of standards that includes *Over the Rainbow, Our Love is Here to Stay,* Ellington's *In a Mellow Tone, Someone to Watch Over Me, Stardust*, and a marvelous version of Manny Albam's *Melody of Jazzland* on which Roger Kellaway performs his chores at the harpsichord. The recording captures the sound of Webster's tenor sax more successfully than any other on which I've encountered him.

The Bob Hammer Band: Beatlejazz!
ABC Paramount Mono ABC-497

A collection of instrumental versions of some of the hit tunes popularized by those long-haired gentlemen from Liverpool, the present set features such well known jazz performers as Joe Newman and Rolf Ericson, trumpets, Phil Woods, alto, Milt Hinton, bass, and Osie Johnson, drums, together with the requisite amplified guitars. While the sound on this platter is merely average in quality, it is vastly superior to that on most Beatles releases. However, performance standards are not quite so fine. These players are an able bunch of professionals, but this music requires a limber, relaxed manner of playing and phrasing that the present group doesn't seem to grasp as well as the Boston Pops did in its famous version of *I Want to Hold Your Hand*. For good instrumental versions of *And I Love Her* and *A Hard Days Night*, the Beatle's own sound track platter can't be surpassed. These boys are really fine musicians who swing superbly. But the sound on their discs is appalling, and it will tax the equalization and tone controls of a good sound system to the utmost. If your phonograph doesn't have variable tone settings for every octave, you may end up prefering the slightly four square Bob Hammer versions to the originals. At least they sound as if they were recorded at the right speed.

Jolly Joe and his Jug Band
Piedmont PLP 13160

This is the most authentic, *country* sounding of the recent crop of jug bands. Much of its interest stems from the originality of the material it offers. Instead of presenting a program of traditional blues and country music performed in the carefully imitated style of the famous skiffle groups of the thirties, this outfit has chosen a program that includes only three traditional numbers, *Goofus Rag, Careless Love and Borrow Love and Go*. The other nine numbers in this collection are all original material written by Joe Bussard and Bob Coltman, who, along with Oscar Myers and Jerry Marcum, make up the entire personnel of the band. Each of these men performs on a variety of instruments, and at various times you can detect guitar, banjo, harmonica, mandolin, violin, washboard, kazoo, tablespoons, comb and tissue, as well as jug. Performances are a trifle rough, but polish has never been considered one of the criteria for evaluating a jug band.

The Judy Collins Concert
Elektra Stereo EKS-7280

Recorded at her Town Hall concert in March, this platter is further demonstration of the remarkable abilities of this moving young folk singer. Whether in poignant ballads such as *Bonnie Boy is Young* or social commentary like *The Lonesome Death of Hattie Carroll* and *Medgar Evers Lullaby*, Judy manages to project the mood of each in a direct and personal manner. The silence of the audience throughout her performances is a telling tribute to the accomplishments of this fine singer, but their enthusiastic applause at the end of each number might have been tactfully faded out a bit sooner on this disc.

The Kentucky Colonels: Appalachian Swing!
World Pacific Stereo 1821

Here is a fine collection of Bluegrass music played by one of the most polished country instrumental groups. Outstanding is the mandolin playing of Roland White and the three finger style banjo plucking of Billy Ray. One of the truly impressive aspects of the Colonels' performances is that they really swing instead of simply bouncing. This is happy, infectious music played in clean crisp fashion with each note sharply articulated and a total absence of the flashy fakery that often rears itself in groups of this type. In keeping with the fine quality of the performance, the recording is a model of wide range stereo without any gimmicky effects.

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EQUIPMENT PROFILE

GOODMANS MAXIMUS I LOUDSPEAKER SYSTEM

The Goodmans Maximus I is the smallest loudspeaker system we have ever encountered which is appropriate for use with high fidelity components. In this 10½-in. wide x 5½-in. high x 7¼-in. deep box the Goodmans people have managed to pack two speakers, a crossover network, damping material, and a surprising amount of music-reproducing ability.

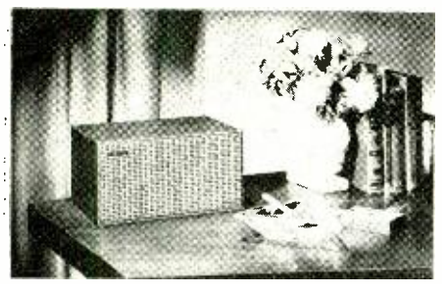


Fig. 1. Goodmans Maximus I Loudspeaker System. Note size in relation to other objects.

In the past we have encountered miniscule speaker systems whose performance matched their size, and we could rightly say that it takes a large system to achieve large sound. Of course, we did not mean that all large systems are better than smaller systems; there are some bookshelf-sized speaker systems which will stand up to all but the most elaborate systems. But we had not imagined that a box *that* small could produce so much musical sound, unaided by special electronic circuits.

The woofer contained in the Maximus I is about 3-in. in diameter and has a 3½-lb. magnet. The L-C crossover network crosses over at 1900 cps to the slightly under 3-in. speaker which handles the mid and upper frequencies. Both speakers are cone type. The enclosure appears to be sealed so that the woofer is acoustically loaded. The high-frequency speaker is isolated from the enclosure by means of a metal cover to prevent interaction between it and the woofer.

The Maximus I is rated at 15 watts continuous. We drove it to its limit, and slightly beyond, with no harmful effects. In addition it appears able to withstand substantially higher peaks without being damaged. Musically, however, when driven beyond its limit continuously, it tends to lose some of its musical quality. This is not a fault since we were operating it beyond the manufacturer's ratings. The reason we mention it is to clarify its limitations so that you will not be tempted to use it in the wrong application. If you need greater power handling ability use one of its big brothers, the Maximus II or III.

The Maximus I has a very musical voice as we mentioned earlier. It provides rich bass reproduction although measurements indicate it begins to roll off at about 160 cps. Useful low-frequency energy is available below 100 cps. Of greater importance, the balance between the mid- and bass frequencies is such that the bass reproduction seems full. We would imagine, however, that the big brothers of the Maximus I (II and III), with a larger number of the same woofers, would provide even fuller bass.

Undoubtedly, the musical quality of the Maximus I derives from the smoothness of its response curve. In its effective frequency range there are few speaker systems smoother.

In essence, the Maximus I is an excellent choice for medium-powered component systems, and, because of its size, ideal for audiofans with space problems. It should also be a big hit with the decor-minded because it is visually so unobtrusive. Circle 196

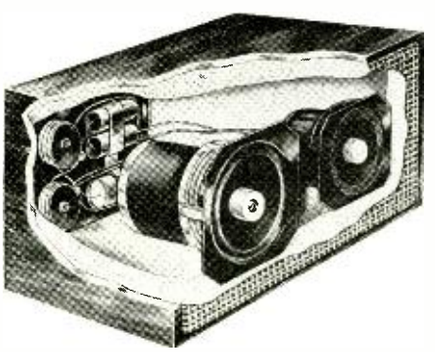


Fig. 2. Cutaway of Maximus I revealing two speakers and crossover network.

MAGNECORD STEREO TAPE RECORDER, MODEL 1024HF

Magnecord is an old and well respected name in the tape recorder field. The Magnecord people have been making professional tape recorders for many years. The 1024HF is essentially a professional recorder with less costly "fittings" (knobs, and so on) intended to tempt the serious audiofan. Its main attraction for the audiofan is its less than $600 price tag coupled with its professional facilities and construction.

The 1024HF records and plays back stereo through its ¼-track stereo heads (one head for record, one for playback), and has built-in provision for an additional ½-track stereo head to play back ½-track stereo tapes. It also records and plays back ¼-track mono. It handles reels up to 8-in. in diameter.

The 1024HF accepts inputs from a pair of high-impedance microphones or auxiliary source. Controls are available on the front panel to mix these two sources in any desired ratio and a master control then controls over-all level. A similar arrangement, individual channel controls plus a master, is used for playback. The VU meters are also individually controlled to show source input, tape output, and bias level.

Two tape speeds are provided, 7½ ips and 3¾ ips, which are selectable by means of a switch. The capstan motor is a two-speed hysteresis-synchronous unit of extremely rugged construction. Separate motors are used for the supply and takeup reels. All motion is controlled by means of pushbutton-actuated solenoids, as is the head gate. The solenoids are set so that tape motion is prevented and the head gate is opened in case of power failure, or if the power is cut off for any reason. Pressing the cue button engages the head gate. The reels can then be "rocked" by hand for cueing or editing.

The reproduce head feeds a signal to the base of the grounded-emitter 2N2613 input transistor which is directly coupled to the base of a 2N405, which is also in a grounded-emitter configuration. Equalization is achieved by means of a negative feedback path from the collector of the 2N405 to the emitter of the 2N2613. The signal then goes through the gain controls which are external to this board and back to the base of a 2N1304 whose output is directly coupled to the base of a 2N1305, another amplifier stage. The output transistor a 2N1304, is connected as an emitter follower. A portion of the signal from the 2N405 supplies the metering circuit.

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It also keeps the heads engaged during fast forward or rewind. This permits locating a particular selection quite rapidly.

The electronics of the 1024HF is a separate package from the transport and uses transistors exclusively, each function mounted on its own plug-in printed-circuit board. Thus there are two playback amplifier boards, two record amplifier boards, an oscillator board, and a power supply. In addition there is space for further plug ins for future use. Provision is also incorporated for remote control, a natural extension of solenoid operation.

Transport Mechanism

The heart of the tape transport is a heavy die-cast plate upon which all of the mechanical transport components and the related electrical parts are mounted. Motive power is provided by means of a two-speed hysteresis synchronous motor which is coupled by means of a flat woven belt from a pulley on the motor shaft to the capstan flywheel. In addition to the large capstan flywheel, the rear end of the motor shaft has a large flywheel-fan mounted on it, and the stabilizer roller also has a large flywheel. These three flywheels ensure unusual speed constancy.

The takeup and supply reels are mounted directly to the shafts of two split-capacitor torque motors. In RECORD, PLAY, or FAST FWD modes, the takeup motor applies torque to the reel for smooth operation. In REWIND, it applies back torque to prevent over-run. The supply motor applies back torque during RECORD, PLAY, and FAST FWD modes and reels the tape during the REWIND mode. The pressure roller brings the tape into contact with the capstan during RECORD and PLAY.

Braking is accomplished by means of differential band brakes which are actuated by one solenoid. Each reel turntable has a flat woven strap wrapped around it which is contacted by a flat steel band for instant and gentle braking when the brake solenoid is de-energized. Altogether a simple and positive braking system which works well.

Speed variations caused by the takeup and supply reels are reduced, or eliminated, by means of the tape-break and compliance arms which act as mechanical filters. The tape-break arm is located around the stabilizer roller and cuts off power to the tape transport when the tape breaks, or at the end of the tape. The compliance arm takes up tape until the take-up reel comes up to speed.

The tape gate incorporates steel lifters for wrapping the tape around each head. Positive guidance is achieved by means of a series of guides inside the gate. The heads are positioned in a sturdy bracket and shielded by removable mumetal shields. All head plugs are notched to indicate orientation and are color coded to indicate which head it is; black is the erase head, red is the record head, and so on. The gate is opened, lifting the tape away from the heads, in the REWIND or FAST FWD modes, and also when power is cut off.



Fig. 3. The Magnecord 1024HF Stereo Tape Recorder.

Circuit Description

The electronic chassis consists of five plug-in circuit boards and a power supply. The boards are for record amplifier (2), reproduce amplifier (2), and bias oscillator.

The power supply provides 6.3v a.c. to power the various lamps and indicators, regulated -17v d.c. to power the amplifiers and the oscillator, and an unregulated 24v d.c. to power accessories. The power transformer secondary has two windings, a 6.3v winding for the lamps, and a center-tapped 36v winding. A pair of diode rectifiers, 1N3193, are used to provide the filtered (1000 μf capacitor) but unregulated 24v d.c. The regulated 17v d.c. is provided by using a GC551 transistor as a series regulator with a zener diode, 1E17Z5, to control the base voltage. The regulated supply is designed to maintain 17 ± 1.5v d.c. for loads up to 0.5 amp with line variations from 105v a.c. to 125v a.c.

The record amplifier contains four transistors per channel, the input stage being a microphone preamplifier consisting of a grounded-collector 35688 transistor (2N2613 with base) stage intended for use with a 50k microphone. The individual channel, and master, gain controls are not on this board but the output of the preamplifier stage is fed to these controls and is returned to the base of a 2N1305 which, in conjunction with several feedback networks, provides low-frequency boost as well as some high-frequency boost. A portion of the recording signal at this point is tapped off to go through the meters and, if the meter switch is set at source, the signal is sent through the reproduce amplifier for monitoring. The output of the 2N1305 is also sent to the base of a 2N1304 which is a grounded-emitter amplifier stage with feedback from the collector of the following transistor, another 2N1305. High-frequency equalization is provided through this feedback path, the amount of equalization being varied to coincide with 3¾ ips or 7½ ips speeds. The signal to the record head is taken from the collector of the last 2N1305 and fed through an L-C series trap to eliminate bias from the record circuit.

The bias oscillator is a straight forward push-pull oscillator which derives its positive feedback from a winding on the oscillator transformer. Adjustments are provided to balance the circuit to eliminate asymmetry in the output waveform. The secondary winding of the transformer steps up the voltage levels for erase and record heads. For mono recording a dummy load is switched in to load the channel of the erase head not being used in order to maintain a constant load on the oscillator, and keep the bias currents at the correct level for all recording modes.

Instruction Manual

Before continuing on to the performance, we must take note of the excellent instruction manual accompanying this machine; it is the most complete and instructive manual we have ever encountered in a machine of this class. This manual contains ten sections including: General Description, Installation and Connections, Operating Instructions, Tape Transport, Amplifier, Tape Transport Maintenance and Adjustments, Amplifier Tests and Adjustments, Accessories, Parts Identification, and Schematics. This 76-page manual contains all the information one would desire concerning the 1024HF, and it is presented in a clear albeit formal style.

Performance

An extremely important performance characteristic is the way a tape transport handles tape. The Magnecord 1024HF performs exceedingly well in this area. We found control of the tape positive and smooth in all modes, and also very quick. We used this machine for a remote recording session and were quite pleased with its responsiveness. Also it is relatively quiet as compared to other machines commonly used for professional recording purposes, thus making it extra useful for on-location recording. (The two cases weight about 50 lb. altogether, about 35 lb. for the transport and 15 lb. for the electronics.)

The record-playback frequency response was within 2 db from 35 cps to 18,000 cps at 7½ ips. At 3¾ ips the record-playback response was within 3 db from 35 cps to 11,000 cps. Response

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at both speeds was measured with 0.1v input and output recorded at −15 db below 0 VU.

Crosstalk was −49 db measured by recording a 1000-cps signal at 0 VU on one channel (both channels in the record mode) and reading the playback level on the other channel with playback gain set to produce 0 VU on the recorded channel.

Flutter and wow measured 0.13 per cent at the 7½-ips speed and 0.18 per cent at the 3¾-ips speed. Speed accuracy was within 0.05 per cent. Signal-to-noise ratio was 51 db at 7½ ips and 46 db at 3¾ ips.

Altogether the Magnecord 1024IIF is a tape machine well suited for the serious recordist in both function and price considering its heavy-duty construction and all its built-in functions. **Circle 197**

ADC "Brentwood" Model 303A

The ADC "Brentwood" is a two-speaker acoustic suspension speaker system, bookshelf sized, whose "voice" is much larger than its size. In fact, the 303A produced more bass from an 8-in. woofer than we have ever heard from an 8-in. speaker to date.

Of course, as we all well know, bass production is not the only important quality of a speaker system. More important is the 'balance' of the various frequencies. For example, a speaker with *mucho* bass and a dip in the mid-range sounds "over-bassy" and often rather muddy, especially in small rooms. On the other hand, a slight almost flat slope downward of the bass frequencies from the mid and high frequencies often sounds far better, and in many locations is ideal.

The indication of a properly balanced speaker system is rather negative; none of the frequency bands is more prominent than another. Naturally, in the average modern room, which is really small, some frequency ranges are boosted by the room acoustics. Thus a flat response in most room environments does not indicate a flat speaker system. For the modern room indicated, the slightly sloping curve we mentioned gives good results.) On this score, in our listening room, the ADC "Brentwood" acquitted itself quite well. The bass doesn't come out and bump you over the room, but rather it is there when needed, when the music calls for it.

The 8-in. woofer is of the long-excursion type with a very compliant suspension. The crossover network which keeps high frequencies from the woofer is mechanical; a section of the woofer cone is made to prevent high frequencies from reaching most of the cone. A capacitor in series with the dome tweeter blocks low frequencies.

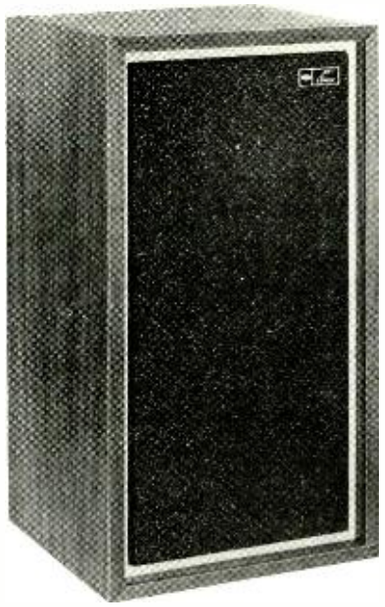


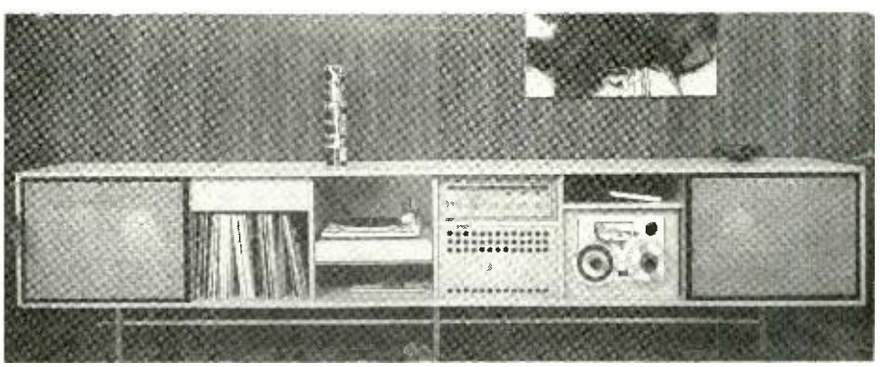
Fig. 4. The ADC "Brentwood" Model 303A Speaker System.

Frequency response of the system was quite smooth both in instrument and listening tests; within 3 db from 35 cps to 17,000 cps with a slight peak at about 12,500 cps, undoubtedly due to a resonance in the Mylar dome of the tweeter.

The Brentwood is rated for operation with amplifiers up to 60 watts and its impedance is 8 ohms. Distortion measured fairly constant (4 per cent) over the frequency range and rolled off smoothly at the bottom end. Transient response was fair, heavily-modulated piano passages with sharp attack tending to block up somewhat.

After extensive listening, we came to the conclusion that the ADC "Brentwood" produces generally clean, uncluttered sound and is well worth consideration by the speaker-hunting audio-fan. And it costs less than $100. **Circle 198**

THIS MONTH'S COVER



A President's Audio System

When the president of a firm dedicated to the manufacture of high fidelity equipment wants to install a sound center in his home, the problems are not necessarily different than those of ordinary customers, at least as regards the design of the cabinet which is to include the components, and the necessity of harmonizing the styling with the total decoration scheme. This is always a challenge to the designer, since the final idea must not only comply with the technical aspects but also conform to the tastes of the owners of the home, where —*cherchez là femme!*—the wife will surely express her preferences.

One solution is shown here in the home of Julio Kohan, president of Ken Brown Argentina, in Buenos Aires. When Mr. Kohan presented the problem to the engineers and designers in his firm, he offered them an exceedingly challenging task, because he is a music lover with a sensitive and discriminating ear and his wife is equally discriminating in the area of interior design.

The components, shown in *Fig.* 1, are: The amplifier and preamplifier are the Ken Brown Studio 70; the changer is a Garrard Type "A"; the tape recorder is a Viking Model 86; the phono cartridge is a Shure Stereo Dynetic Model M44-7; the loudspeakers are 12″ Tannoy Monitor built into the custom cabinet.

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NEW LITERATURE

• **Scott Console Catalog.** H. H. Scott, Inc., has made available the new 1965 Scott Console Catalog. This full-color 20-page idea book displays the whole range of Scott stereo consoles, and includes photos and details on the new Scott Stereo Compact. All models are shown in appropriate room settings, both contemporary and traditional. The technical details of stereophonic sound are clearly explained in nontechanical language, and articles and photographs are included describing the audio components and cabinet construction of the Scott consoles. H. H. Scott, Ic.
Circle 208

• **Guide to Record Care.** A new guidebook on the care of long playing and stereo records is announced by Elpa Marketing Industries, New Hyde Park, N. Y. The booklet is called "How to Clean, Maintain and Protect Records." Written by Cecil E. Watts, world-renowned record-care authority, the 16-page manual is said to be the most complete guide to the care and treatment of records ever written. It describes professional procedures for handling, cleaning and storing records, and tips on rejuvenating old records for renewed life. According to Mr. Watts, many more records are discarded because of damage in handling than are worn out by actually playing them. "Improvements over the last few years," he points out, "have resulted in such immaculately polished disc surfaces, to provide a silent background and give the listener the nearest approach to actual concert hall reproduction, that it is very necessary, in fact, vital, that records now be kept free from dirt, dust, micro-films of grease and, most important of all, static. The combination of these contaminations, if allowed to accumulate in the groove bottom, become disastrous. The solution lies in the correct, indeed scientific, care of records at all times, before playing, during playing, and in handling and storing." Among the chapters included in the new manual are the Miracle in the Groove, a complete description with microscopic photographs showing the effect of contaminants on the record groove, Dust and Static, Theory of Static Behavior, Requirements for Various Playback Conditions, How to Handle Records, Rejuvenation of Records, Treatment for Other Types of Records, and many others. It describes all necessary cleaning equipment for the protection and maintenance of long playing and stereo records. The new Cecil E. Watts booklet is available for 25 cents by writing to Elpa Marketing Industries, New Hyde Park, N. Y.

• **Wire and Cable Catalog.** The Belden Manufacturing Company has released its Electronic Wire and Cable Catalog 864. Thirty-five new numbers are introduced. Among the new items are: Control Cables: To their wide range of control cables Belden now offers, as stock items, 12 new types. These cables are designed specifically for the control and power supply functions in electrical and electronic applications. These additions make available 22 AWG up to 25 pairs, rated at 200 volts, 18 AWG up to 15 pairs, rated at 400 volts, 16 AWG up to 19 pairs, rated at 600 volts, and 14 AWG up to 12 pairs, rated at 600 volts. FEP Teflon Cables: 8390—2 conductor 8391—3 conductor and 8392—4 conductor teflon cables expressly designed for extremely low and high temperatures. Rated at −54 deg. C and +200 deg. C these cables have superior electrical properties, particularly outstanding in dielectric strength and insulation resistance. Paired Cables: For higher level in audio systems Belden adds 3 pair, 6 pair, and 9 pair 18AWG unshielded cables and 16 AWG and 14 AWG Beldfoil (aluminum-Mylar) shielded single pair cables. Quads: Belden now lists a 3-quad shielded cable and a 7-quad shielded cable. Design for schools that call for a multi-function system each quad can supply individual rooms with variations of sound, telephone, annunciator or indicator information and singles.

DYNAMIC NEWS FROM ALTEC

2 New Microphones Expressly for Professional Use

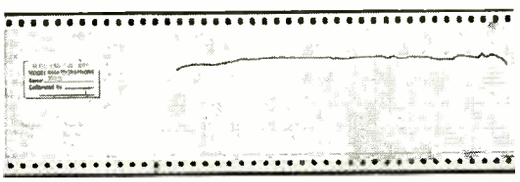
Two new studio dynamics—Altec 688A Omnidirectional; Altec 689A Cardioid—have been developed by Altec specifically for broadcast, recording, and TV use. Part of the famed Altec Series 680, these microphones offer maximal characteristics to meet and exceed the strictest professional recording and broadcast standards. Each is equipped with the exclusive Altec "Golden Diaphragm" which is not only extremely rugged in use but which also contributes inherent low resonance qualities and peak-free response. These two new microphones plus Altec's famed M20 Omnidirectional Condenser Microphone System and M30 Cardioid Condenser Microphone System now offer the industry superb qualities and characteristics to meet any and all requirements that can be imagined.



ALTEC 688A OMNIDIRECTIONAL DYNAMIC MICROPHONE—$90 net. Extremely uniform response from below 35 to over 20,000 cycles. Highly efficient. Low hum pickup. Shown in an Altec 181A Boom Mount. Output Impedance: 30/50, 150/250 and 20,000 ohms (selection by connections in microphone cable plug). Output Level: −55 dbm/10 dynes/cm². Hum: −120 db (Ref.: 10^{-3} Gauss). Dimensions: 1⅛" diameter at top (1½" largest diameter), 7½" long not including plug. Weight: 8 ozs. (not including cable and plug).



ALTEC 689A CARDIOID DYNAMIC MICROPHONE—$108 net. High front-to-back discrimination for an average of over 20 db from 40 to over 16,000 cycles. Virtually flat response throughout this frequency range. Output Impedance: 30/50, 150/250 and 20,000 ohms (selection by connections in microphone cable plug). Output Level: −54 dbm/10 dynes/cm². Hum: −120 db (Ref.: 10^{-3} Gauss). Dimensions: 1½" diameter at top, 7 13/16" long not including plug. Weight: 11 ozs. (not including cable and plug).



Each 688A and 689A microphone comes with its own individual response curve made by a Bruel & Kjaer servo-driven recorder in conjunction with an Altec anechoic chamber. The curve serves as a permanent record of the unit's response characteristics for immediate reference at any time required.



ALTEC M20 OMNIDIRECTIONAL CONDENSER MICROPHONE SYSTEM—$233 complete with base, stand attachment, and power supply. This is the famous "Lipstik"—so named for its miniature size—the only American-made condenser on the market. The M20 provides the wide, uniform frequency response of a laboratory standard—an exceptional microphone for broadcast and recording of highest quality.



ALTEC M30 CARDIOID CONDENSER MICROPHONE SYSTEM—$280 complete. This directional microphone offers the superb response characteristics of the condenser with the ruggedness and small size available only from Altec. 20 to 20,000 cycle range with better than 10 db front-to-back discrimination at the extremes, better than 20 db in the mid-range.

ANNOUNCING AN IMPORTANT NEW DIVISION AT ALTEC

The Audio Controls Division was recently organized at Altec Lansing Corp. The new division specializes in design and manufacture of precision attenuators, equalizers, filters, networks and switches, as well as custom consoles and associated products specifically for the recording and broadcast industries. It is headed by Arthur C. Davis, a Fellow of the AES and well-known in this field as a leading design engineer and manufacturer.

For specific engineering details and free demonstration, call your nearest Altec Distributor (see Yellow Pages) or write Dept. AM11.

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ANAHEIM, CALIFORNIA

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HERMAN BURSTEIN

(Note: To facilitate a prompt reply, please enclose a stamped, self-addressed envelope with your question.)

Herman Burstein
280 Twin Lake E., Wantagh, N. Y.

Small-Reel Wow

Q. In using 1-mil tape on a 3-in. reel at 7.5 ips, I get a great deal of wow near the end of the reel. Using the standard 7-in. reel of 1.5-mil tape I do not seem to get this wow. Is it the machine, the small reel, or the 1-mil tape that is the source of my difficulty?

A. The tape itself is unlikely to be the cause. Probably your machine is at fault, and the difficulty is aggravated by the smaller reel size and smaller hub. See what happens after you rewind the 1-mil tape on a standard 7-in. reel.

Eliminating Hiss

Q. I wish to copy some foreign language tapes which contain an excessive amount of hiss. Is there some way of filtering out the higher frequencies and thereby reducing the hiss?

A. You can try the following three things: (1) Record at 3.75 ips instead of 7.5 ips, or possibly at 1⅞ ips if your machine affords this speed; (2) increase the bias current above its normal value; (3) interpose a very thin, smooth material, such as cellophane paper, between the tape and the record head.

Mysterious Thump

Q. When recording and playing back simultaneously, but without an input signal, an occasional thump is heard in playback. This happens on several brands of tape, so that defective tape isn't the answer. The trouble occurs on both channels. What could cause this?

A. Two possibilities occur to me. One is a defect in your bias oscillator, with resultant distortion in the bias waveform. The other is possible leakage of d.c. to the record head. Check the coupling capacitor from the record head driver to the head. Also check the coupling capacitor from the bias oscillator to the record head.

Sudden Distortion

Q. My tape recorder operates fine for a while, then all of a sudden and for no apparent reason the recording becomes distorted. The distortion seems to be in the nature of a "drop out." I am inclined to believe that the fault lies either in the record head or in the bias oscillator section. I have tried different heads, but to no avail. I have completely rewired the oscillator section, but again without improvement. I even replaced the entire preamp. Again no change. The pressure pads have been changed many times.

A. Have you tried replacing the oscillator coil in the bias oscillator circuit?

Uneven Wind

Q. When tape is wound on my tape recorder in the fast forward and rewind modes, it does not accumulate evenly on the reel, but winds with the tape edge "shuffled" in and out. I have read that this uneven distribution tends to distort the tape physically, and likewise the recorded material. What can be done to cause the tape to accumulate more evenly?

A. Few if any home machines wind the tape as smoothly in the fast wind modes as in the normal operating mode. Slowing down the winding speed should help to distribute the tape more evenly, but for a practical method of doing so you will have to seek elsewhere. To minimize the effect of uneven winding, it is suggested that before playing a tape which has been stored for a long time you unwind and rewind this tape at fast speed. If you have recorded a tape that you plan to store for a long time before playing, the final wind should be at normal operating speed.

Calibrating a VU Meter

Q. How should I go about calibrating the VU meter in my tape machine for recording purposes?

A. Feed in a 400-cps signal and increase recording gain until 3 per cent harmonic distortion is produced on the tape, as measured in playback. Then reduce the input signal 6 db. Finally, adjust the calibrating pot so that the reduced signal causes the meter to reach the maximum permissible point as indicated on its dial—0 VU in the case of a VU meter.

VU Meter Drive

Q. In my tape recorder the VU meter is driven directly by the recording amplifier and is influenced by the record equalization: Am I incorrect in assuming that this is a rather inaccurate method of indicating recording level?

A. It is a common and perhaps prevalent practice for the meter to follow the equalization circuit, because thereby you "see" everything that is presented to the tape. The chief cause of distortion is excessive signal presented to the tape, and if recording equalization causes a tremendous boost of the high frequencies, it is desirable that the meter take notice of this.

On the other hand, I am not sure that it is good practice for the meter to be driven directly by the recording amplifier stage. This depends on the impedance of the meter circuit relative to the output impedance of the amplifier stage in question. If the meter circuit has at least 10 times as great an impedance, and preferably more, the load presented by the meter will probably cause little distortion.

Standard VU Meter

Q. The VU meter of my machine is not calibrated as a standard VU meter. That is, it has no decibel scale but merely indicates if the recording level is too high or low. Is there an advantage in substituting a standard VU meter?

A. Yes. A dial calibrated in VU or decibels permits you to make fine adjustments in recording level, depending upon the type of material being recorded.

Tape Machine Output Level

Q. Please advise me whether a tape machine which delivers an output signal of 1.5 volts can be connected to a preamp rated at 0.5 volt input without introducing distortion.

A. Three things can prevent the preamp from being overloaded: (1) You can turn down the playback gain control of the tape machine; (2) if the volume control of the preamp precedes all tube stages (except for magnetic phono), this control can be adjusted to prevent overloading of the preamp; (3) if the signal going into the preamp goes through an input level-set, this can be turned down to prevent overloading.

Avoiding Feedback

Q. The instructions for my tape recorder state that I should not leave the output connected to an amplifier when recording, or the input connected to an amplifier when playing back. Why is this?

A. One reason is to avoid the possibility of feedback due to a mistake on the part of the operator. When recording, if you accidently put your amplifier's selector switch to the tape playback position, there would be a continuous path from the amplifier's tape output jack to the tape recorder input, to the tape recorder output, to the amplifier, to the amplifier's tape output jack, and so on. This would set up a howl.

Another reason is to eliminate the possibility of grounding the signal you wish to record. Some amplifiers ground all unused inputs, including the signal from the tape machine. In the case of your machine, the signal to be recorded also appears at the machine's output jack; if the output cable were left connected to the amplifier, the latter would ground the signal that was to be recorded.

Squeaking Machine

Q. I recently joined a tape club, and three of their tapes often but not always produce an audible squeak about 200 feet from the end of the reel. This appears to originate at the tension guide on the side of the supply reel. Most times the squeak is amplified by the tape machine. I have tried obvious solutions, such as cleaning the heads and rollers. Each of the three offending tapes is on a reel with a large hub, and changing to a different reel does not eliminate the squeak. Other tapes that I own present no problem. I would appreciate your suggestions.

A. It appears that your three particular tapes are at fault, quite possibly lacking sufficient lubricant. Or they may have lost moisture, which can be restored by enclosing the tape in a container, along with a moist sponge, for a day. You might try lubricating the tape guide where the squeak originates, using one of the special preparations sold at audio stores. Tape lubricants are also available.

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How Many Motors?

Q. I am interested in a good quality home recorder, and I have acquired specifications on several units. Some in the $500 range use only one motor, while others priced about the same or even lower use two motors or three. Assuming all other specifications are about equal, which do you believe is best—one motor, two, or three?

A. I think that the proof of the pudding is still in the eating. I would go on the basis of performance. That is, I would put each of the machines I was considering through the various paces of tape handling to see which is easiest on the tape, offers the greatest convenience, and so on. Since the Ampex 601 came out a number of years ago, there has been decreased stress on the idea that more than one motor is essential for professional performance, at least in the home. On the other hand, where a tape machine has to work many hours a day and most days of the year, ruggedness, durability, and such aspects of performance rise in importance, and here the three-motor unit is apt to have an advantage. Also, ultra-fast winding is easier to achieve without damage to the tape when more than one motor is employed.

Dynamic Range

Q. Please explain what is meant by the dynamic range of a tape recorder. How do you test for it? How do "superior" heads improve the dynamic range?

A. The dynamic range of a tape recorder corresponds to its signal-to-noise ratio in conjunction with a particular tape. Signal-to-noise is usually measured by recording a 400-cps tone at a level producing 3 per cent harmonic distortion on the tape; playing back and measuring the output level; simultaneously erasing and rerecording the tape with no signal input; again measuring the output level (noise); and comparing the two output measurements. This noise includes hum and hiss of the record and playback amplifiers, the results of poor erasure, the results of poor oscillator waveform, and tape hiss. The signal-to-noise ratio is dependent upon the tape because the amount of signal that can be imposed on the tape before reaching 3 per cent harmonic distortion varies somewhat among tapes. The ratio is dependent upon the playback head because signal output varies among heads; a head designed only for playback tends to have higher output than one which must serve for both recording and playback. The ratio depends upon the amount of bias current employed, because a relatively large amount of bias permits a somewhat higher recording level before 3 per cent distortion is reached; since treble response declines with an increase in bias, the choice of tape again plays a part.

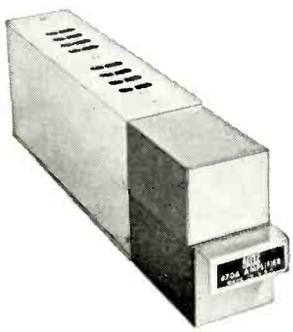
Bias Frequency

Q. From what I gather, most tape recorders have a bias frequency between 50 and 60 kc. I have been told that a unit with a frequency of 40 kc is at the very borderline of usability. Is this true? Would variations of design within the unit compensate for low bias frequency?

A. What you say is true, at least for high fidelity purposes. The lower the bias frequency, the greater is the danger of audible beating between harmonics of the audio frequencies and the oscillator frequency. I don't see how variations of design could compensate for the problem of low bias frequency.

A SURVEY OF RECORDING AND BROADCAST ENGINEERS IS THE SECRET BEHIND THE NEW ALTEC 470A AMPLIFIER & 550A POWER SUPPLY

Before we did anything else, we surveyed hundreds of recording and broadcast engineers. Guided by the results, we built the 470A Amplifier and the 550A Power Supply. They provide both the size and capabilities you asked for. And the versatile 470A can serve as a preamp or line, booster, and program amp with no internal changes needed!

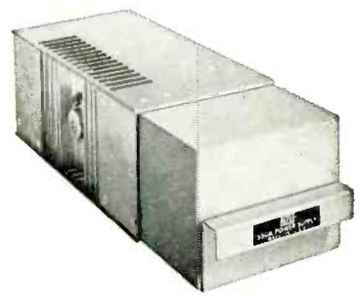


NO SACRIFICES FOR THE SAKE OF MINIATURIZATION

Most of you felt that miniaturization had gone too far. So the Altec 470A Amplifier is slightly larger than some "subminiature" models. But you'll still get eight in a 19" rack and occupy only 3½" height. That size difference you requested will help with the age-old heat problem with all the attendant damage. Another thing, the modern, all-silicon solid state design is rugged, compact and fully enclosed. Inputs and outputs are completely isolated. And larger "plug-in" connectors simplify wiring and circuit tracing; easier to connect and solder. Its sensible size makes it easier to maintain and service, too. On top of that, the Altec 470A Amplifier has a lower noise level than any tube amplifier designed for this function. And, it excels in patching applications because it is unaffected by length of transmission lines (over 100 feet fore and aft)!

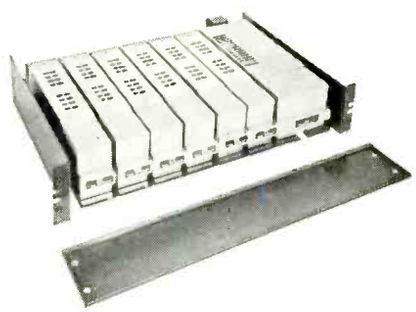
CHECK THESE SPECS— YOU'LL LIKE THEM:

GAIN: 45 db (input terminated); FREQUENCY RESPONSE: ±0.5 db, 20-20,000 cps; POWER OUTPUT: +27 dbm max., 20-20,000 cps; DISTORTION: Less than 1% THD, 20-20,000 cps, with +27 dbm output; NOISE LEVEL (unweighted, 10 cycles to 25 kc band-pass): Equivalent input noise, −127 dbm (input unterminated); OVERLOAD RECOVERY TIME: 5 micro-seconds for 100% overload.



ALTEC 550A POWER SUPPLY ASSURES TROUBLE-FREE OPERATION

An all solid state device, the Altec 550A can power up to fifteen 470A amplifiers at full output. The design includes an external sensing circuit to insure that the output voltage will remain constant regardless of line voltage fluctuations. Output ripple and noise is only 200 microvolts under the full 2 amp load.



ACCESSORIES:

ALTEC 850A AND 852A TRAYS— Needed for mounting 470A and 550A whether in rack, console or bench use. Gold-plated receptacle permits instant plug-in of amp or power supply.

ALTEC 800A MOUNTING FRAME— Accommodates up to eight 470A Amplifiers in 850A Mounting Trays or a combination of amplifiers and power supplies.

Now in production! Altec new 61A and 63A Program Equalizers and three variable filters: 67A high and low pass, 68A low pass, 69A high pass will be ready for delivery soon. Write for complete specifications.

For Technical Literature or Ordering Information, Write to: AUDIO CONTROLS DIV.

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Tape Hiss

Q. To what extent does the design of a tape recorder affect tape hiss? Does a machine without pressure pads produce less tape hiss?

A. The design factors that affect the audibility of tape hiss are: (1) *Choice of playback equalization.* NAB equalization provides a great deal of bass boost, which is the equivalent of a great deal of treble cut. Hence hiss can be substantially reduced by use of such equalization. (2) *Tape speed.* As speed is reduced, large amounts of bass boost in playback become impractical. Hence, in effect, there is less treble cut and tape hiss becomes more audible. At speeds of 3.75 ips and less, particularly less, a variety of equalization characteristics are used by different manufacturers, with varying consequences for hiss.

I am not aware that pressure pads contribute to tape hiss, although they can play a part in tape squeal.

Matching Mike Impedances

Q. I own an Eico RP-100 and would like to use with it two microphones that are respectively rated at 200 ohms output impedance and 50–250 ohms output impedance. However, I don't get enough gain. What do I have to do to make these mikes work with the Eico?

A. The Eico is designed for high-impedance microphones, whereas yours are low impedance. You require suitable microphone transformers to convert from low to high impedance, with an accompanying stepup of input signal.



Just this! Only the FAIRCHILD 688 Power Amplifier delivers a true and continuous 50 Watts (not music power) at any frequency from 10 cycles to 50,000 cycles, and with a low, low distortion under 1% with full 50-Watt output! Only the FAIRCHILD 688 Power Amplifier produces clean, and reliable 50 Watts into 16 ohms! Only the FAIRCHILD 688 Power Amplifier is stable enough to keep on producing 50 Watts at any frequency up to 50KC – not for a second, or 5 or 10 seconds, but continuously without damage to the transistor circuitry! Only the FAIRCHILD 688 Power Amplifier, with transformer-free output, produces 50 Watts with outstanding transient response.

Only the FAIRCHILD 688 has the **New Exclusive TRANS/GARD** overload protection system. The electro-optical TRANS/GARD system allows input of the amplifier to be overloaded by as much as 40 db and still only result in a 1 db change in output of the amplifier. FAIRCHILD TRANS/GARD does not dissipate the power handling capabilities of the FAIRCHILD 688 50-Watt design. This amazing TRANS/GARD system, which does not introduce distortion, protects the amplifier and speaker systems from burnout. Only the 688 and TRANS/GARD prevent sound reinforcement systems from blasting listeners out of their seats due to inexperienced performers in front of a microphone. The unique FAIRCHILD TRANS/GARD system protects the transistors, transducers, loudspeakers and even the listener!

The Model 688 is available with or without transformer input, and a 70V line transformer output is available as an option. Gain 83 db. Sensitivity .15V for 50-Watt output. Height 3½"; Width 19". Rack mountable.

Write to FAIRCHILD – the pacemaker in professional audio products – for complete details.

FAIRCHILD RECORDING EQUIPMENT CORPORATION
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Insufficient Record and Erase Current

Q. I own a professional tape transport to which I have fitted Brush stereo heads: play BK-1072, record BK-1072R; erase BK-1072E. I then built a Knight stereo record-play preamp to use with this machine. When the unit was tried, the following shortcomings were noted: (1) Insufficient record current; (2) insufficient erase current.

A. The new heads you are using are professional-grade heads of low impedance, so that their current requirements are higher and their voltage requirements lower than those of the heads customarily employed in home tape machines. To supply enough current, you need a different oscillator transformer. I suggest that you communicate with Knight. Or you might build a new oscillator circuit around a transformer supplied by Nortronics.

Regular Pitch Variations

Q. When playing recorded tapes, I notice on occasion that the music exhibits a regular pattern of pitch variations. A sustained note on any instrument sounds unsteady. Or the massed sound of instruments appears to fade slightly away from full volume at regular intervals. A sustained note on the oboe sounds like a series of clicks. I would appreciate any suggestions you might have as to the cause and remedy of this difficulty.

A. I suggest that you play the tapes in question on a machine of unquestioned quality at an audio dealer or at a friend's home. If the wow and flutter continues, obviously the tapes are to blame and you have every right to expect a refund or exchange from your dealer. If your own tape machine is to blame, I suggest that you clean the heads and guides and follow the manufacturer's instructions, if any, with respect to motor lubrication, pressure pad cleaning or replacement, cleaning of the belts, idler wheels, and so on. If these measures don't help, consult the authorized service agency for your tape machine.

Defective Tapes

Q. Out of the first six recorded tapes I bought, three had defects in the form of stretched edges so that dropouts occurred in the channel recorded nearest the edge. These tapes were from leading recording companies. Upon requesting replacement, two of the tapes were replaced with good copies, but the third has been replaced twice with results no better than the original tape. Is this a common occurrence in your experience? I play the tapes on a machine which has no pressure pads. On another machine, which does have pads, the problem disappeared. Short of adding pads to my present machine, is there anything you can suggest? I have no trouble with my own tapes, only with the commercially recorded ones.

A. I have not personally run into the problem of tape stretching at one edge, but this does not necessarily mean that your problem is unique. Have you tried playing the problem tapes on other machines that have no pressure pads? If they play properly on such machines, the fault would appear to lie basically in your machine. Possibly one or both reels ride too high on the spindle, so that the tape does not follow a proper path. On the other hand, the recorded tapes that are giving you trouble possibly came from a bad batch, with the replacements having come from the same batch. Ask the recording company, rather than your dealer, for replacements. Æ

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DYNAGROOVE

(*from page 23*)

that in some recorders the amplifiers driving the heads were on the borderline of being inadequate in power output to provide overload of the tape without considerable distortion in the amplifier. In these instances, corrective measures were taken to insure that the magnetic tape was the limiting element in the system from the standpoint of overload.

The three main factors to be considered in the performance of a magnetic tape recorder and reproducer are frequency range, signal-to-noise ratio, and tape-speed constancy.

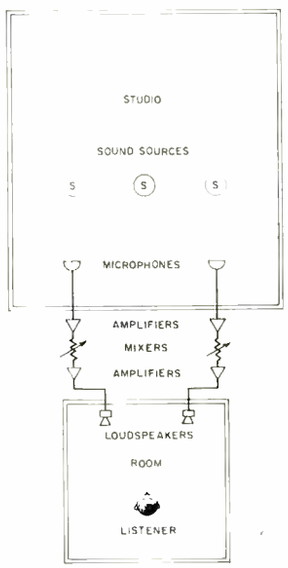


Fig. 5. Stereophonic sound reproducing system used in subjective tests of microphone placement with respect to the sound source.

The frequency response characteristic needs very little consideration for the higher tape speeds employed in professional recording because there is no problem in achieving uniform response from 30 to 15,000 cps within a fraction of a decibel.

An adequate signal-to-noise ratio presents one of the most difficult problems to achieve in the recording of master magnetic-tape records. There are three forms of noise in magnetic-tape recorders, the uncorrelated or random noise due to the particle nature of the tape, the random or uncorrelated noise due to modulation produced by small non-current but rapid variations in motion of the tape and head contact with the tape, and the correlated noise due to print-through. An improvement of three decibels was achieved in the random signal-to-noise ratio by using a tape speed of 30 ips. A significant increase in the

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We designed it that way. Small enough to fit into any room. Handsome enough to be welcome there.

But small size and good looks are only the beginning. The Model Sixteen really delivers all the advantages of transistor design that you've been promised for so long.

This is a full powered, full performance amplifier, with 70 watts of wide-band steady state power — 200 watts of peak power.

This is clean power . . . KLH clean. Distortion levels are insignificant from 25 to 20,000 cps.

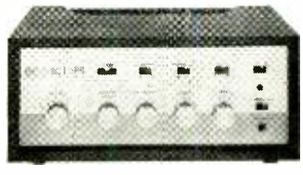
This is reliable power, far beyond the potential of any tube amplifier. (There is no known aging process in a transistor.) The Sixteen can't be shorted out or burned out in use. A unique electronic circuit, designed by KLH, eliminates the need for fuses or circuit breakers in the speaker outputs.

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signal-to-noise ratio as well as the maximum output level was obtained by the use of a new tape with higher retentivity and a lower noise level. Wow and flutter were improved 50 per cent by the higher tape speed.

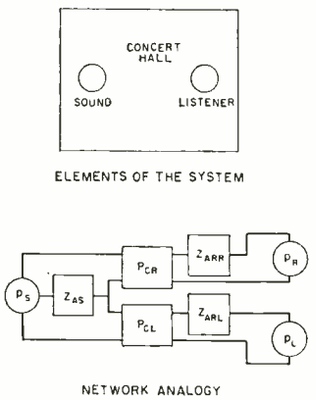


Fig. 6. Concert hall or other enclosure and listener and the acoustical analogy.

Dynamic Spectrum Equalizer

An original master tape produced with the equipment described in preceding sections will exhibit clarity, presence, low nonlinear distortion, uniform transfer characteristic and all the desirable characteristics described in the preceding sections. This tape can be transferred without any alterations to produce an excellent disk for reproduction in the home. The question arises as to whether it will sound like the original live music when played back on the consumer's home instrument in his own living room. The answer is "no" for the reasons which will be developed in this section.

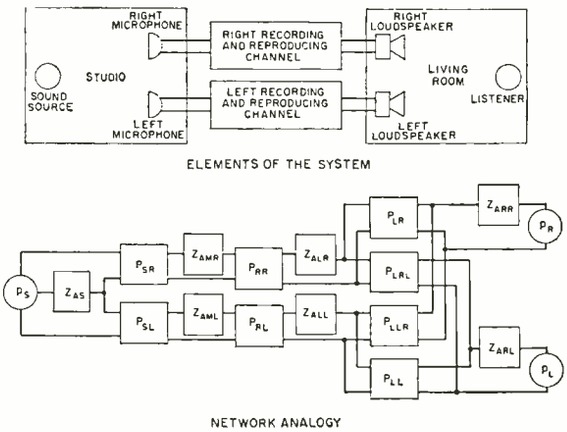


Fig. 7. Complete sound reproducing system and a listener and the acoustical analogy.

A consideration of the auditor listening to a live program in a concert hall and the auditor listening to a reproduced program in the home, from the standpoint of dynamic analogies will indicate the major problems that must be solved in order to provide the auditor in the home with sound reproduction which exhibits the highest order of artistic and subjective resemblance to that of the auditor in the concert hall.

A simple approximation for a concert hall, or other acoustic enclosure a single sound source, and a listener is represented by the dynamic analogy of *Fig.* 6. There is first the sound pressure, p_S and the acoustical impedance z_{AS} of the sound source. The sound source is coupled to two quadripoles, with propagation constants P_{CR} and P_{CL}, which represents the acoustics of the concert hall between the sound source and the ears of the listener. At the listener, there are the acoustical impedances z_{ARR} and z_{ARL}, and the generated sound pressures, p_R and p_L, at his ears.

ACOUSTICAL REARGUARD | FOR SUPERIOR SOUND



Insensitive to sound reaching this dynamic microphone from the rear...An exceptionally pronounced cardioid pattern produces an acoustical shield of approximately 180° that effectively isolates unwanted sounds originating from noisy audiences, feed-back or reflection.



A high quality condenser microphone for music and speech. Its characteristics provide truest fidelity for reproduction and recording. The C-60's many uses and users attest to the unusual versatility of this microphone. Available with either cardioid or omni-directional capsule.

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A simple approximation of the chain consisting of a sound source in a studio, two-channel stereophonic recording and reproducing system, and a listener in a living room is represented by the dynamic analogy of *Fig.* 7. There is first the sound pressure, p_S and the acoustical impedance z_{AS} of the sound source. The sound source is coupled to two quadripoles with propagation constants, P_{SR} and P_{SL}, which represents the acoustics of the studio between the sound source and the microphone. The acoustical impedances of the microphones are z_{AMR} and z_{AML}. The microphones are coupled to quadripoles with propagation constants, P_{RR} and P_{RL}, which represent the sound recording and reproducing equipment. The outputs of the quadripoles representing the sound reproducing equipment are coupled to the loudspeakers with coupling acoustical impedances z_{ALR} and z_{ALL}. The loudspeakers are coupled to four quadripoles with propagation constants, P_{LR}, P_{LRL}, P_{LLR} and P_{LL} which represent the acoustics of the living room between the loudspeakers and the ears of the listener. At the listener, in the living room, there are the acoustical impedances z_{ARR} and z_{ARL} and the generated sound pressures, p_R and p_L at the ears of the listener.

Certainly no one could conclude that if the sound recording and reproducing equipment of *Fig.* 7 displayed a perfect transfer characteristic, that the results obtained by the listener in *Fig.* 7 would be the same as that in *Fig.* 6. Therefore, a perfect transfer characteristic is not the ideal transfer characteristic.

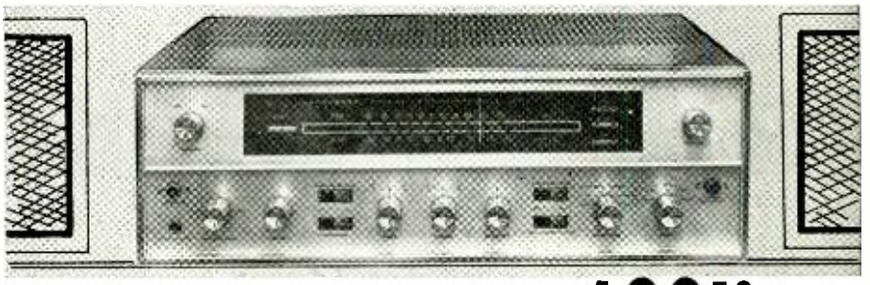
From the preceding discussion, the conclusion follows, that a perfect transfer characteristic in the sound recording and reproducing system is not the answer to a simulation of the concert hall or other live performance. The next logical step is a consideration of the factors involved in providing the listener with sound reproduction, which exhibits the highest order of artistic and subjective resemblance to that of the live condition in the concert hall or other enclosure.

Extensive subjective tests have been conducted on the stereophonic reproduction of sound at various loudness levels under the acoustical conditions and environments of the average living room in the home. Studies have also been made of the reproduction level employed by consumers in their homes. These tests have shown that peak level of sound reproduction in the homes of consumers runs for 70 to 90 decibels for 90 per cent of the listeners. The average listener in the home operates a record reproducing system at a peak level of 80 decibels.

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NEW! LAFAYETTE 70-WATT COMPLETE AM-FM STEREO RECEIVER

Just Add Speakers and Enjoy FM, FM Stereo and High-Quality AM Reception



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■ A powerful 70-Watt Amplifier plus Complete Preamplifier Control Facilities plus a Standard AM Tuner plus a sensitive FM Tuner plus an FM Stereo Tuner—all on One Compact chassis ■ Amazing FM "Stereo Search" Circuit Signals Presence of Stereo Broadcasts ■ Tuned Nuvistor "Front End" provides Greater Sensitivity, Lower Noise ■ Bar-Type Tuning Indicator for AM and FM ■ Variable AFC Control ■ Imported

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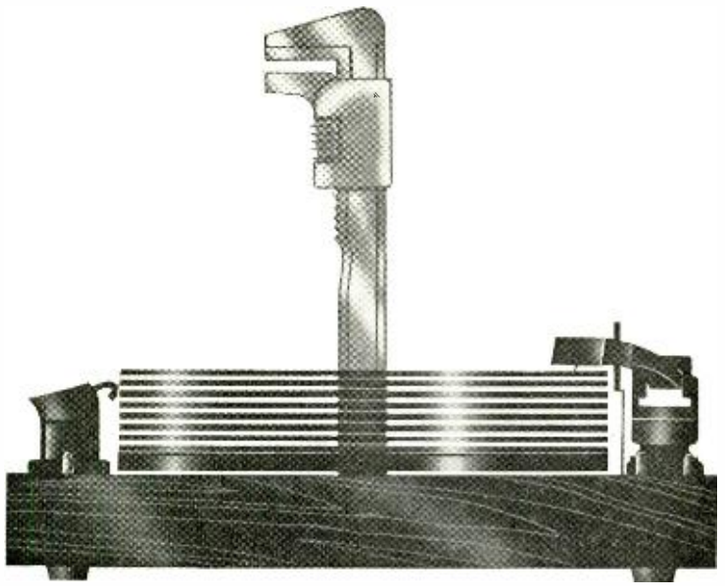
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The peak level[9] of sound delivered by a symphony orchestra in the concert hall is about 100 decibels. Thus, it will be seen that the peak level of sound reproduction in the home is much lower than the level in the concert hall.

The main reason why the average listener prefers a lower level of sound reproduction in the home as contrasted to the sound level in the concert hall, is that the tolerable peak sound level in a small room is lower than the tolerable peak sound level[10] in a large hall. The shorter mean free path and resultant faster growth and decay of sound in a small room appears to lead to a lower tolerable peak level in the small room. Subjective tests have indicated that the same results are obtained regardless of whether the sound program is live or reproduced.

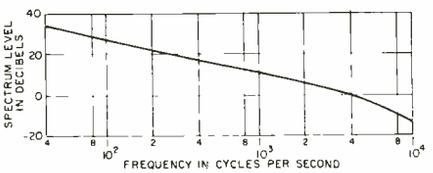


Fig. 8. Average noise spectrum for residences. 0 db = 0.000204 dyne per square centimeter (After Fletcher and Hoth).

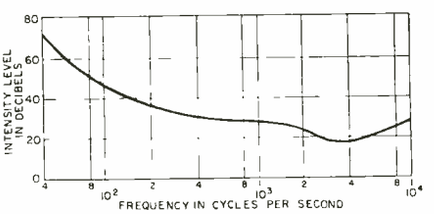


Fig. 9. Hearing limits for pure tones for a typical listener in a typical residence. 0 db = 0.000204 dyne per square centimeter.

The ambient noise level [11] in the average residence is a factor that must be considered in the reproduction of sound in the home. The ambient noise in 90 per cent of the residences falls between 33 and 52 decibels.

The spectrum of room noise[12] shown

[9] Peak level in these considerations is used to designate a level at which 95 per cent of the program lies below the peak level.

[10] The term, tolerable peak sound level, is used to designate the peak level of sound reproduction, which the listener feels is acceptable and agreeable.

[11] D. F. Seacord, "Room Noise at Subscribers' Telephone Locations," *Journal* of the Acoustical Society of America, Vol. 12, No. 1, p. 183, 1940.

[12] D. F. Hoth, "Room Noise Spectra at a Subscribers' Telephone Locations," *Journal* of the Acoustical Society of America, Vol. 12, No. 4, p. 499, 1941.

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in *Fig.* 8 is a factor which must be considered in the reproduction of sound in the home. The most significant aspect of *Fig.* 8 is that the noise increases with decrease of the frequency.

The next consideration is the masking[13] of the reproduced sound program by the ambient noise. In the case of wideband noise of the type encountered in rooms, it is possible to have masking from the spectrum level and the masking contours of the noise. *Figure* 9 obtained in this manner depicts the hearing limits for pure tones. That is to say, a tone of a level below the curve of *Fig.* 9 cannot be heard. A direct listening test was carried out to determine the threshold of pure tones for a small room exhibiting an ambient noise spectrum as shown in *Fig.* 8. These tests substantiated the characteristic of *Fig.* 9 within the usual limits of subjective tests. The threshold characteristic of *Fig.* 9 then established the lower level of hearing in a room in the average residence.

The peak level of sound reproduction in the average home situation is 80 db. The data of *Fig.* 9 and the peak level of 80 db of sound reproduction established the amplitude limits of the reproduced sound in the home for the average listener. The relatively low peak level of sound reproduction and the ambient noise level in the home are among the main factors which must be considered in providing realistic sound reproduction for the consumer in the home. Within this framework, there are three other important characteristics that must be considered in the reproduction of sound in the home: The loudness-*versus*-intensity relation in hearing; the response frequency characteristic of equal loudness in hearing; and the reverberation characteristic of the average room in the home.

The equal loudness frequency relation of hearing or the response frequency characteristic of the human hearing mechanism has been determined by several investigators.[14, 15, 16, 17] As far as the compensation in going from one level to another for a change of 20 decibels or less is concerned, which is the point of interest in the design of the Dynamic Spectrum Equalizer, the response frequency characteristic of the human hearing mechanism serves a guide for the subjective tests which will be described later on and which serves to establish the performance characteristics of the Dynamic Spectrum Equalizer. The response frequency characteristics of the human hearing mechanism as depicted in *Fig.* 10 indicate that certain of the frequency ranges must be increased or decreased in amplitude in order to maintain the quality balance of music when it is reproduced at a lower level than the original.

In the reproduction of sound in a room there are two sources[18] of sound

(Continued on page 89)

[13] H. Fletcher and W. A. Munson, "Relation Between Loudness and Masking," *Journal* of the Acoustical Society of America, Vol. 9, No. 1, p. 1, 1937.

[14] H. Fletcher and W. A. Munson, "Loudness—Its Definition, Measurement and Calculation," the Acoustical Society of America, Vol. 1, No. 1, p. 82, 1933.

[15] B. G. Churcher and A. J. King, "The Performance of Noise Meters in Terms of the Primary Standard," *Journal* of the Institution of Electrical Engineers (London), Vol. 81, No. 1, p. 57, 1937.

[16] D. W. Robinson and R. S. Dadson, "A Redetermination of the Equal Loudness Relations for Pure Tones," British *Journal of Applied Physics*, Vol. 7, No. 5, p. 166, 1956.

[17] International Organization for Standardization, Draft Recommendation R. 226. 1960.

[18] Olson, "Acoustical Engineering," D. Van Nostrand Co., Princeton, New Jersey, 1957.

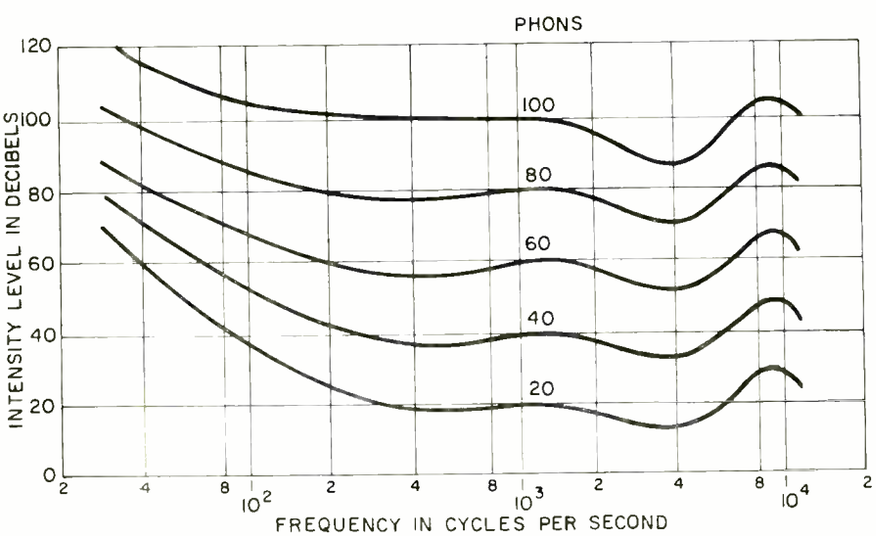
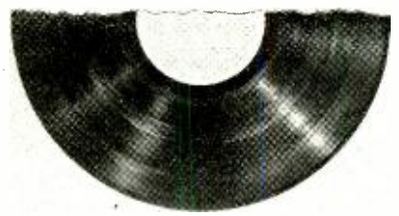


Fig. 10. Contour curves of equal loudness. 0 db = 0.000204 dyne per square centimeter.

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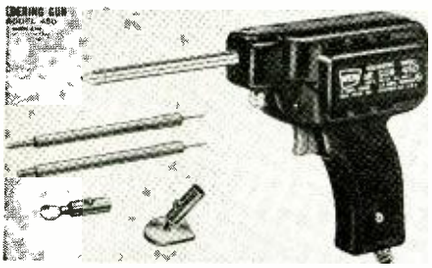
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NEW PRODUCTS

from page 36

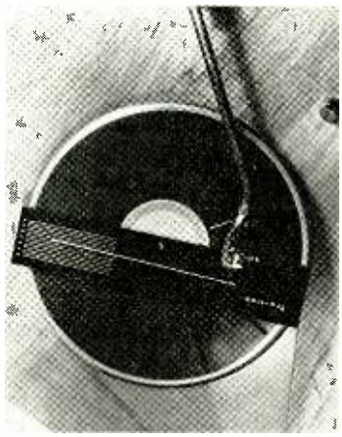
● **Soldering Gun.** Wen Products, Chicago manufacturer of electric portable power tools, has engineered a new concept in soldering instruments, the Model 450 "All" soldering gun that makes possible heat volume ranges from 25 to 450 watts in one small, lightweight gun. Simply by changing tips, which can be done in seconds with just two screws, the Wen All-Gun is automatically ready for heavy, medium, or light duty. Heavy duty applications, using the standard 5/16-inch tip, would include such jobs as copper plumbing pipe joints, gutter and downspout repair, and



auto radiator repair. The medium tip may be used for splicing heavy electrical wires, appliance and toy repair. The fine-line tip is suitable for printed circuit work, TV and radio hookup jobs, and stranded wire splicing. The gun measures 9¼ inches long. It weighs 35 oz. plus 3-oz. cord. List price is $13.95. In addition to the heavy duty tip, Part No. 45A7, included with the All Gun, the fine point tip, Part No. 45F7, and medium duty tip, Part No. 45M7, are available; all are priced at $1.30 each.

Circle 211

● **Device for Measuring Tracking Error.** TRU-TRAK, a device that shows visually the amount of "tracking error" in record players and positions the tone arm for optimum performance, has been developed by ALARD Products, Somerset, California. TRU-TRAK is a visual tool that eliminates the necessity of working with complicated calculations and difficult hairline measurements in determining the proper mounting position for the tone arm. The use of TRU-TRAK to read tracking error makes it possible to achieve less



distortion and greater fidelity with maximum stereo separation. TRU-TRAK consists of a pointer assembly that attaches to the cartridge and a calibrated scale that fits over the turntable spindle. As the tone arm is moved across the turntable, the pointer indicates visually, the tracking variations of the tone arm. By changing the mounting position of the tone arm, the increase or decrease in tracking error is readily apparent. The mounting position that produces the minimum amount of movement on the scale is the proper positioning for greatest fidelity with the particular tone arm and cartridge being tested. TRU-TRAK is precision made from Lucite, fits standard cartridge mounting and can be installed in minutes. Price is $6.95 postpaid.

Circle 212

● **AM-FM-Stereo Tuner.** Lafayette Radio Electronics Corporation has added a new AM-FM-stereo tuner. The Lafayette Model LT-325 features a "Stereo Search" circuit which produces an audible signal in both channels when a stereo station is tuned in. Tuner sensitivity is 2 μv for 20-db signal-to-noise ratio. Its frequency response is from 15–15,000 cps ±1 db, and channel separation is better than 38 db at 400 cps.



Built-in ferrite loopstick antenna is used for AM reception, and a 300-ohm impedance antenna input is provided for FM reception. Finished in dark beige and measures 14¾ W × 5⅝ H × 9½ D with legs. The net price is $93.95. Lafayette Radio.

Circle 213

● **Speaker Mechanism.** The new Utah PA8JC-WCR features cloth roll suspension for smoother bass response and dual cones for reproduction to 20,000 cps, according to the manufacturer. It has an embossed transformer-mounting area (for transformers up to 2⅜ in. mounting centers), shallow construction (only 3 in. deep), internal dust cap for positive protection of the close-tolerance voice-coil gap and screw terminals. Specifications in-



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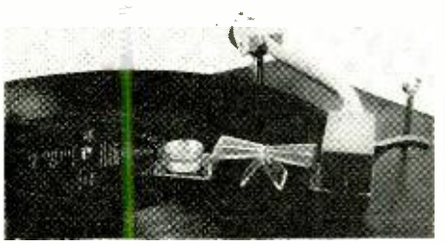
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clude 10-oz. barium ferrite magnet, 1 in. voice coil, a peak power rating of 30 watts, and frequency response of 30–20,000 cps. The speaker is finishd in a baked-on, blue lacquer for resistance to moisture. The list price is $12.95. Utah Electronics.
Circle 214

• **Needle-Force Gauge.** Acoustic Research supplies a needle force gauge of the balance type with its turntables, and also sells these gauges separately for $1. The design of the gauge has recently been improved. The heels of some cartridges would sometimes touch the pan and interfere with the freedom of the arm; with the new design this can no longer



happen. AR announces that all owners of the earlier type gauge (they are identified by the cross marks on both pans) may write for a free replacement balance arm of the new design. While they are at it, says the company, they should check to see if any of the weights have been lost. These will also be replaced at no charge. Requests should be sent to: Acoustic Research, Inc., 24 Thorndike Street, Cambridge, Mass. 02141. **Circle 215**

RECORD REVUE

from page 40

appreciation of the fine points of these two vigorous early works. Command's engineers, plus some sort of an acoustic armory or equivalent, produce a huge, very live sound that makes the two works sound bigger than life—which is quite OK. They *are* bigger than their early-type styling sometimes suggests.

As for Szell, he and his men operate on the Beethoven Fifth and the Mozart "Jupiter" like the man in the Cadillac after the long red light; the music is fast, hard, brazen, impatient, cold and furious at the same time, giving the lyric parts short shrift in the urge to get on and through, hammering the louder parts with trip-hammer violence. One long scowl, almost from beginning to end, and not my idea at all of a desirable new version of these so-often-recorded items. Beethoven's Fifth, of course, can take a lot of hard-as-nails tension. But the "Jupiter," unbearably tense in essence, needs humanism, lyricism, sympathetic understanding if it is to get over its agonizing message and its superhuman musical ingenuity. Oddly, Epic's acoustics are as cold as the music; this is one of those deadish sounds that prompt you to keep turning the volume control up higher to bring it to life.

Before you decide which tape recorder to buy, read this ad.

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Tchaikowsky: Symphony No. 4. Hallé Orch., Barbirolli.

Vanguard SRV 135 SD stereo

Vanguard has enlarged its long-time and low-priced "demonstration" series into a new line, the Everyman Classics, of which this is a sample. There is no observable difference in technical quality between these and the standard, higher-priced Vanguards and Bach Guild. Matter of merchandising.

A number of them are played by this group, the Hallé Orchestra under Barbirolli, and if this is typical, then I—well, I hardly know what to say. It is a very strange "Fourth" though far from a useless one, nor is it unmusical. It's just that there seems here a near-total inability to see the symphony in the large, as the tour de force of sheer nervous energy that it is. Instead, it is played like, maybe, a new piece by Sir Edward Elgar, very British: it is ever so polite, ever so consciencious: it rises periodically to a fine show of bravado—hard not to, as the notes are written—and then subsides into the gentlest English provincialism, playing each theme, each section, as though it were a different piece. First a Handelian fanfare of trumpets, then a turn-of-the-century waltz, oh-so-sweet, then a Germanic development section, followed through with furrowed brow, like a bank clerk adding up figures. . . . But where is Tchaikowsky?

Since most recordings go the opposite way, over-doing the hysterical Tchaikowsky to sheer blatancy, this is a most unusual performance! Those who dislike Tchaikowsky's wailings and rantings will find it pleasant hi-fi! For my ear, it is dressed-up Gilbert and Sullivan, British-Provincial.

Beethoven: The Nine Symphonies. London Symphony, Krips.

Concertape 4T-7001 (4-track stereo tape)

As we all know, 4-track stereo tape has found an oddly parallel market to that of stereo disc, borrowing from a common source of original masters, selling through different outlets and generally to a different set of buyers. Since the masters are the same, separate reviews—at least in the classics—are a waste of space. I mention this big box of four fat reels at 7½ ips simply to take account of the current situation and remind disc buyers that tape still is around, presenting a small but "representative" segment of the enormous mass of material now available in disc form for those who prefer reels to tone arms.

There were grave doubts at the beginning as to whether the high-speed duplicating process used in 4-track really provided any quality advantage (not to mention the doubtful quality of many tape recorders in playback mode). I'd say that the inherent tape advantages are now modestly realized in tapes like this, though improving disc quality in the last years has made the competition pretty tough. The inherent differences are still the important thing—different equipment, different playing methods, different people both in sales and among consumers. It remains a peculiar industry, this 4-track tape, with a reasonably permanent place alongside of, but not replacing, the ever-durable disc.

I seem to disagree mildly with those critics who hailed these Beethoven performances as great. I find them high-level, but high-level routine rather than high-level inspired. A subtle distinction, I'll admit, and it probably won't bother you a bit. I don't much like the way the symphonies are split up to fit on the four tape reels—but discs run into the same problems, after all. Inevitable. The tape box is a "special" and a tape bargain. The disc album is on the Everest label.

Mendelssohn: Complete Piano Music, Vol. IV. (with orchesta).

Vox VBX 414 (3) mono

Nobody but nobody can match Vox at this business of collecting complete works and issuing them in enormous, low-priced omnibus "Vox Boxes." Sometimes they're a gamble—everything is by the same artist and he or she isn't always ideal. The Mendelssohn, though, is split up various ways. I sampled this

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Fourth Volume, remembering some of the original releases, and found the pair of concertos for two pianos and orchestra—rediscovered works, by the way—absolutely delightful. They are early Mendelssohn and belong in the fresh, lively, joyous, alive era of his composition. The pianists, led by the excellent Orazio Frugoni, are superb for the music too. I'd take the rest of the album on faith.

Also excellent is the remastering job—one would scarcely know these were well over a dozen years old, as I think they are. More congrats. (And keep looking at the dozens of other Boxes—in a lifetime I couldn't manage to keep up with them myself.)

Ravel: Piano Concerto in G. Falla: Nights in the Gardens of Spain. Philippe Entremont; Phila. Orch., Ormandy.

Columbia MS 6629 stereo

The mellifluous Philly Orchestra is getting to be the Montovani and the Melachrino of classical music-making. Month after month, Ormandy and his men turn out disc after disc of smooth, slick "classical" and not a one of them is ever bad. But hardly a one of them, either, is played with real conviction and honest ensemble musicianship. It's all too easy, to much of a big smile, too much like public relations. This one is no exception, in spite of one of the finest of the younger French musicians, Philippe Entremont.

Nothing "wrong" with Ravel. It just doesn't come off as it should. The outer movements race, too fast altogether for the content of the music. The Gershwin in them is lost in the general lather. (There's plenty of Gershwin—Ravel had just met him in the U. S. when this concerto was written.) The slow movement is best, since it is mostly piano solo, and there Entremont can take over with real expression. And so it goes. It could be so much better. . . .

These Philadelphia recordings, dozens of them, remind me of those endless Persian rooms, Tahiti hideaways, Balkan bars, Parisian bistros and what-not that you find in all our big hotels and on many a big-city street. Always a flashy effect, a superficial suggestion of the place. Practically never more than a veneer of the real thing. The Philly, as I say, is *never* bad. But oh—if it could only let down its hair and play with all-out fervor, once in a while!

Virgil Fox plays the John Wanamaker Organ—Philadelphia.

Command CC 11025SD stereo

"Wanna-maka" big noise on your hi-fi? Here's some raw material. Darndest sound you ever heard.

30,000 or so pipes when they stopped adding them, and I guess they all still work. It was a sort of hobby organ, installed spang in the middle of Wanamaker's store in an inner court, rising up to a dizzying height. The court is covered and the sides are open balconies for the various shopping floors. So, oddly enough, the acoustics are quite dead—it all goes off sidewise and gets trapped in ladies' wear and bedroom furniture and notions.

This is the arch-example of the "old-fashioned" huge organ, a "Mighty-Wurlitzer" type but with less of the theater and more of the Schmalz. It has more string pipes than any other in the world, and it sounds so. The general idea was to pile sound on sound and the thicker the better. Ladle it out, high-pressure. A roar as of a dozen organs all playing together, or maybe a hundred. Mushy, muddy, blurred, soggy and perfectly enormous.

Don't take the music too seriously. The Fox arrangement of a popular Bach-Stokowsky horror is just an endless dirge. The Love-Death from "Tristan" sounds almost like an orchestra but not quite. The rest sounds mainly like a very big and very noisy organ playing music designed for a very big and very noisy organ. That's what Command was after, after all.

****FIREWORKS!** A Sound Spectacular.** Phila. Orch., Ormandy.

Columbia MS 6624 stereo

OK, fellers, here's Columbia's current best for the big-speaker brigade. Big noise, huge space effect, thumps in the bottom bass and squawks in the trumpets, etcetc. The music is strictly down the line with the Boston—I mean the Phila. Pops. Sabre Dance. (Remember the very first "hi fi" LP, from Columbia?? That was the N. Y. Philharmonic with Kurtz, I think.) The Ride. Dance of the Tumblers. Prelude to Act III of "Lohengrin." In the Hall of . . . Sorcerer's Apprentice. Good solid Nineteenth Century hi-fi, and Ormandy's boys do their best to sound like Arthur Fiedler's. Filled right up with super pep.

Heinrich Biber: Eight Sonatas for Violin and Continuo (1681). Sonya Monosoff; Melville Smith, hps., Janos Scholz, gamba.

Cambridge CRS 1812, 13 (2) stereo

Here's the same superb and winning combination that appeared awhile back in the big Cambridge album of *scordatura* violin sonatas by this man Biber—a really first-rate "unknown" composer, a master of the early aroque, plus an extraordinarily musical lady violinist and an unusually fine sound produced by Cambridge's recording team.

Biber? A Bohemian-born composer who ended up in Salzburg, preceding Mozart there by a century, a contemporary of the great Corelli (nine years older, in fact) and a German Corelli of the violin whose music is just as good for my ear as that of the far better known Italian master. Moreover, it isn't copied—these splendid little sonatas with their virtuoso violin tricks were printed when Bach and Handel were minus-four years old and Corelli himself was not even yet established as a leading Italian composer. Quite extraordinarily rich music of its sort.

Monosoff? She plays with a gorgeous big tone and the most sensitively attuned pitch I've ever heard in a violin. The *continuo* accompaniment, harpsichord and viola da gamba, is excellent, too. It comes from the grave. Melville Smith died in 1962, shortly after these tapes were completed.

Douglas MacArthur. Duty, Honor, Country (1962). Address to the Congress (1951). Complete speeches.

RCA Camden SPC 100 (2) mono

Here's the General himself, at long length, and you're bound to weep, whether with patriotism or sheer boredom or a fine mixture of both. (That sums the man up for me. He was, indeed, a great General if not exactly a great speaker.) He occupies two whole mono LP's here, which'll last you quite awhile. Interesting contrast between the 1951 and 1962 speeches. Age spares no man, even though personality be untouched.

Heifetz-Piatigorsky Concerts. With Jacob Lateiner and Guests.

RCA Victor LSC 2770 stereo

RCA's top-rating violinist and cellist, both getting along in years now, have recently been putting on joint concerts, with "guests." As always, RCA's publicity elevates these into some species of sacred rite, to the awe of the hushed multitudes. In Carnegie Hall, recently, the concerts were gently panned by more realistic critics. However, all is not lost. This is a perfectly good record, if hardly sensational.

Its best feature is the Beethoven Opus 1, No. 1, a trio for violin, cello and piano in which the early-Beethoven "Mozartean" style does not conceal the marvelous expertise and dry humor of the young composer, then the lion of Viennese musical circles. It is all piano and Jacob Lateiner is excellent in the part. Heifetz and Piatigorsky are so subdued one might think the management had used tranquillizers. Not bad—in this music.

The second side gets a bit hammy. The Haydn Divertimento is an arrangement (by Dahl) of an arrangement (by Piatigorsky) of one of the Baryton Trios. It sounds it. The Theme and Variations are from a Double Concerto written for the two principals by the ubiquitous Miklos Rózsa, an extraordinary skillful Hungarian of Hollywood persuasion who writes film music for anything and can do a first-rate imitation of Bartok—as here.

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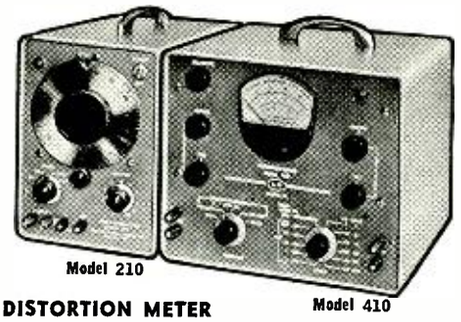
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I certify that the statements made by me above are correct and complete.

Henry A. Schober, Business Mgr.

Turkey (Monitor Presents Songs and Dances of Turkey.)

Monitor MF 403 mono

Monitor's "iron curtain" records all sound about alike—but not this one. This is real Turkish entertainment completely without Western harmony and with lots of oriental ornament, strange scales, instruments, voices, including a super-black-bearded Turkish "troubador," some girls, some men choristers. It's pops music in its own land, both city and country, but it sounds pretty "authentic" even so. Weird. Æ

LETTERS

from page 6

maybe Mr. Klipsch has not tried them —and there are peaky condenser types, too. I believe my presentation gave a realistic balance of the relative merits in general use. Æ

NORMAN H. CROWHURST
Box 651
Gold Beach, Oregon 97444

Room (Not Concert Hall) Acoustics

SIR:

In your April issue appeared an article by J. W. Linsley entitled "A 'Purist' Tackles Room Acoustics." I have been awaiting the appearance of a correction to a fairly major error in the otherwise excellent article. Since no such correction has appeared this letter seems apropos, if tardy.

Mr. Linsley refers to a statement "by one expert that the reverberation time of a concert hall had to be 70 per cent longer at 100 cycles than at 500 cycles." He then attempts to use this rule in acoustic design calculations for his music room.

The expert is correct but note that his statement was for a *concert hall* of dimensions, say, 300 × 200 × 50 ft. (3,000,000 cubic feet) or larger. Few of us have music rooms of such dimensions. For a room of 5000 cubic feet (17 × 21½ × 13½ ft.) the recommended increase in reverberation time is about 14 per cent, 3500 cubic feet (15 × 19 × 12 ft.) calls for an increase of perhaps 12 per cent, and 3800 cubic feet (15½ × 19½ × 12½ ft.) requires about a 12½ per cent increase according to data published by Western Electric Company.

For anyone attempting the acoustic design or repair of his listening room, probably the most comprehensive tables of absorption data at various frequencies which are available can be found in V. O. Knudsen's *Architectural Acoustics*. The text of the book is in general quite excellent although dated in certain areas. It can be supplemented by a reference book such as I. T. & T.'s *Reference Data for Radio Engineers*.

DEAN E. BEKKEN
28734 Lomo Drive
Palos Verdes Peninsula, Calif.

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COMMERCIAL SOUND

(*from page* 46)

This works quite well for speech amplification, but is quite limited for music reinforcement, of course, because the musical harmony is affected by the shift. Acoustic feedback, that results in the familiar howl, is due to standing wave patterns of a particular frequency, so one might be tempted to hope that frequency shifting would eliminate feedback altogether. But this is not so. It does allow a greater increase in gain than does simple frequency elimination, but it has its limits.

When this is understood, it seems that frequency shifting is a sort of "brute force" method, only to be tried when all else has failed. In most instances, a more sophisticated attack on the real problem will yield a better solution. Feedback occurs due to standing waves at specific frequencies that are part of a confused pattern produced over the whole range required by desired sound reinforcement. If reinforcement merely accentuates the sound wave pattern for the desired hearing, without the confusion pattern, there is seldom any serious feedback problem.

So where reverberation is excessive, a system with one or more of three essential features will usually achieve the desired end, and do so more effectively than the frequency shifting method can, on its own. These are: (a) low level distribution, with a greater number of speakers placed more closely to individual sections of the audience;

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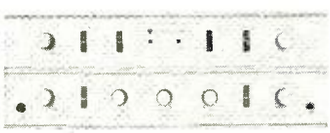
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(b) using speakers with directional characteristics to build up sound where it's wanted and minimize it where it isn't; and (c) using successive delay as a further artificial aid to building up the desired form of acoustic wave.

To summarize: there are five things the electronic part of a system can do to improve effective acoustics: (1) modify response by simple lifts and cuts; (2) eliminate specific frequencies; (3) frequency shift the whole program; (4) provide time delay to signal fed to different speaker groups; and (5) provide electronic switching, for multiple mike working, so only the mike in use is "live" at any instant. Seldom should all of these methods be necessary in one installation.

Now that home stereo has achieved such wide acceptance, many commercial customers are asking for stereo installations for auditorium, restaurants and other places. Some of the "stereo" that has been installed with this objective fails miserably. So our next chapter will include a discussion about how to tackle the provision of effective stereo in various environmental situations.

Question—Chapter 8

Is it true that commercial stereo installations should just be expanded versions of the home stereo installation, or must a different approach be adopted for larger buildings?

Answer—Chapter 8

In some cases, the best method is to enlarge the two-sided presentation used for home stereo. In others a completely different approach must be used. The choice can depend on the type of building, the type of program to be presented and on what the stereo presentation is to do: increase the effectiveness of communication in difficult circumstances, or produce greater realism under circumstances already good. We will pursue this in the next chapter, as well as some of the headaches one can encounter in installation.

AUDIO ETC

(*from page 12*)

away towards some lofty ideal of "perfect" recording that will outdo all their own outdoing and—yes, definitely—even outdo the original, the composer's own idea! Liver than live once again. It can be done, too.

Did Bach know, for instance, how magically the pluck and sheen of three harpsichords plus a small string orchestra can come through in good stereo? Bach wrote two such works (maybe for himself and his two older sons); he played them and heard them, live. He didn't hear them as marvelously as we do! We've gone beyond anything his small concert hall could do for the listeners who heard him play. We can put down more of those harpsichord works on records than he ever could produce in live sound for his listeners.

Of course Bach didn't know what he missed and, you might say, he couldn't care less. We can hardly get his approval for our doings, two centuries after the fact. But we do have his music on hand, we have the harpsichords and the strings, we have the players and our choice of acoustics and of mike settings. And so no live performance on earth is going to keep us from barging ahead artistically into recorded Bach (and plenty else) to see what we can do with the music in our own way—to see what the musical score can do for us. In Bach, it quite often can do a great deal, as I say, even if we can re-create Bach himself and his sons in the live flesh, preserved 45-45 in a V groove.

It is worth repeating that living music, music in the act of artistic production, is never going to be replaced, as long as living musicians remain available and employed. Live music is much too good a thing to be forgotten. Recorded music can never entirely take its place. Recorded music is still predicated upon the sound of live music, though it is not a literal reproduction of it.

Nor will recorded music attempt to replace living musicians with electronic

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machines. Not for the music we know, at any rate, music which is made by people for people.

Remember that music is a people-product, whether live or recorded. It is 100 per cent an art of communication between human beings, any way you look at it. We aren't interested in a zombie music, music by machines, for machines; or maybe just for nothing. Music is people-stuff—live or recorded. Minus people, it is just noise, so much more unnecessary wave-frontage in a faceless universe of eternity. Who wants that?

As long as we exist, we will prefer people to mere things, or most of us will. People are the spice of life. Without people, we'd have an awfully dull time. And so as long as recording exists as an art it will remain "live" in the most profound sense, by which I mean artfully appealing to the human ear and mind and senses, ingeniously put together by people, for people. Liver than live, actually more lively than life itself.

Æ

ELECTRONIC ORGAN DESIGN

(*from page 26*)

The Flute Celeste tab, for example, must turn on both the Celeste rank and the 8-ft. unit Flute and must also select Flute tone from the Celeste rank tone changer. It might also be found desirable to have it activate an auxiliary attenuator which slightly reduced the level of the unit Flute. A Flute Celeste is usually a fairly soft voice. The Dulciana Celeste tab must perform similar switching functions with the Celeste and Principal ranks.

This organ is quite a bag of tricks. Feel like a little fugueing? The Primary Chorus might comprise the Solo Open Diapason 8-ft. coupled to Manual I plus the 4-ft. Principal, 2⅔-ft. Twelfth, 2-ft. Fifteenth and 1⅓-ft. Larigot. When you get to the episode go up to Manual II using the 8-ft. Flute, 4-ft. Flute, 2-ft Principal and 1-ft. Sifflote. These registrations should contrast nicely. The 2-ft. Principal is the only common component.

In the mood for a good, lush, romantic wallow? Try some appropriate melody on the Solo Concert Flute with Tremolo. Accompany it on the Dulciana Celeste of Manual II. How about the unusual registration you worked out down at St. Whoosit's where you put the cantus firmus of a chorale prelude on a 4-ft. reed in the Pedal? No problem at all; couple down the Solo Clarinet with the Solo to Pedal 4-ft. Both manuals are still free for contrasting registrations for the other parts. Would you thrill to the sound of the Purcell "Trumpet Tune"? Use the Solo Tuba against all of Manual I. Want to play the Boellman "Gothic Suite"? The Solo Trompette can be coupled at 16-ft., 8-ft., and 4-ft. for the necessary chorus reed effect. Other registrational possibilities will doubtless occur to those readers who are organists.

As to power amplifiers and loudspeakers, most readers will have their own ideas. One word of caution, however. With an electronic organ one is making music in one's own environment—not reproducing music that someone else has made in some other environment. This has an important and often unrecognized significance in terms of loudspeaker placement. Unlike a music reproducing system, it's best to "aim" the loudspeakers almost anywhere except at the listener or player. The objective should be to increase the ratio of reflected to direct sound. One suspects that many a would-be electronic organ builder has produced disappointing results by ignoring this simple principle. The addition of electronic reverberation will also prove most rewarding.

In closing, I can only say that this represents my ideas on a satisfactory electronic organ. I sincerely believe that this instrument would be more rewarding to play and would better fit the needs of the vast body of literature for the organ than many of the electronic organs now on the market. Though it will certainly be more expensive than many instruments, its sound will amply justify the cost.

Æ

EXPONENTIAL HORNS

(*from page 33*)

equation[5] have already been defined and plugging them in for our particular case gives

$$C_{mt} = \frac{2\ (0.0173)}{(0.079)^2\ (1.18)\ (344.8)^2\ (1.09)} = 0.0362 \times 10^{-3} = 36.2 \times 10^{-6} \text{ meters/newton}$$

Eq. (6)

Now, knowing this we can equate the total positive capacitance—composed of the speaker compliance C_{ms} and rear chamber compliance C_{mb}—to the negative capacitance C_{mt} for cancellation. This is done by the relation

$$\frac{C_{ms}\ C_{mb}}{C_{ms} + C_{mb}} = C_{mt} \text{ meters/newton}$$

Eq. (7)

To illustrate, let us assume we already

[5] Beranek, op. cit., p. 282.



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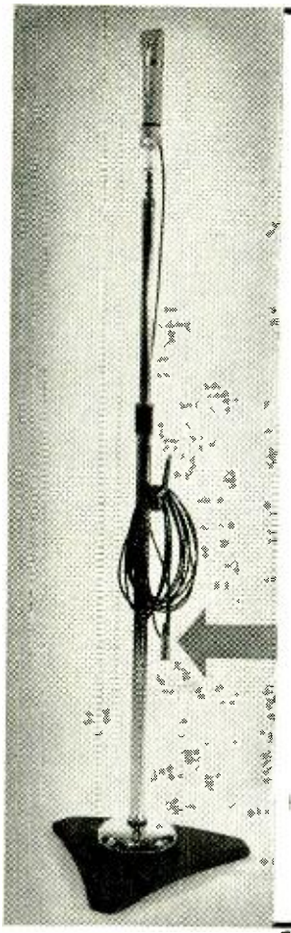
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know C_{ms}. For the Lansing speaker C_{ms} is 276×10^{-6} and therefore from Eq. *(7)*, $C_{mb} = 40.8 \times 10^{-6}$. The volume of the enclosed air chamber is found from[6]

$$V = 1.4 \times 10^5 \, S_d^2 \, C_{mb} \text{ meters}^3$$

$$\text{or } V = (1.4 \times 10^5) \ (0.079)^2 \ (40.8 \times 10^{-6})$$

$$= 0.0356 \text{ meters}^3 = 1.26 \text{ ft.}^3$$

This is the volume required for one speaker. Four speakers require four time as much volume or 5 cu. ft.

This almost finishes us up except for explaining how C_{ms} can be measured. In *Fig.* 3 we had an experiment for measuring the *Bl* product. Using the same setup only without the power supply, place the calibrated weight on the cone again and this time measure how far the cone drops. This distance, in fractions of a meter, divided by the weight in Newtons, is C_{ms}.

Perhaps we should take stock of where we stand now. We have designed a horn-speaker system matched to the proper amplifier impedance (32 ohms) and at high efficiency (43.7 per cent). Horn dimensions were chosen in advance so that the response would be within 3 db above 33 cps. For this latter requirement, the horn length became 10.5 ft. and the mouth area was 24 sq. ft. Four 15 in. woofers were required to drive it with an enclosed volume behind them of 5 cubic ft.

Since this *is* rather large, maybe we can pull one last trick. Everything is stereo now and it would be rather awesome to have two enclosures this size around. Rather, let's cut it in half, so to speak, . . . one half for each channel. This brings each enclosure down to two woofers and a mouth area of 12 sq. ft. Both systems will function together at low frequencies as one unit so nothing is being compromised. Enclosures this size are, although still big, within the realm of reason and quite practical to build.

Nothing now remains except to get on with the construction. I have purposely left out such interesting topics as horn folding, the design of acoustical cross-over networks and high-frequency peaking. The former is more of an art than a science and explaining my method would take more pages than it is worth. The latter two require a little more knowledge of acoustical theory than the sketch I have presented and these techniques aren't always useful anyway. For a front-loaded corner about all that is required are the basic horn dimensions and the volume of the air chamber behind the speakers. For those of you wishing to pursue this matter further I heartily recommend the books by Beranek and Olson already cited in the footnotes. Æ

[6] Beranek, op. cit., p. 129.

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model
P-83C Custom



3-SPEED PROFESSIONAL TURNTABLE
Turntable : 30 cm aluminum alloy casting 1.5 kg.
Motor : 4-pole hysteresis synchronous condenser motor
Speed : 33-1/3, 45, 78 r.p.m.
S/N : Over 50 db
Wow : Below 0.2%

NEAT

NEAT ONKYO DENKI CO., LTD.
4, 1-chome, Kanda, Hatago-cho, Chiyada-ku, Tokyo, Japan
Circle 144 on Reader Service Card

POWER AMPLIFIER

(from page 21)

provide many years of completely trouble-free service. The amplifier works equally well into an open or a short, or a speaker, and the fuses act with more than ample speed to protect the output transistors. The pulse response of the amplifier is excellent, free of ringing and overshoot, and the clipping waveform is very clean. As might be expected, the low-frequency response of this amp is very good, and crossover distortion is absent at any level or frequency. All of the semiconductors for a stereo version of this amp may be purchased for less than the cost of a pair of output transformers, and four output tubes necessary

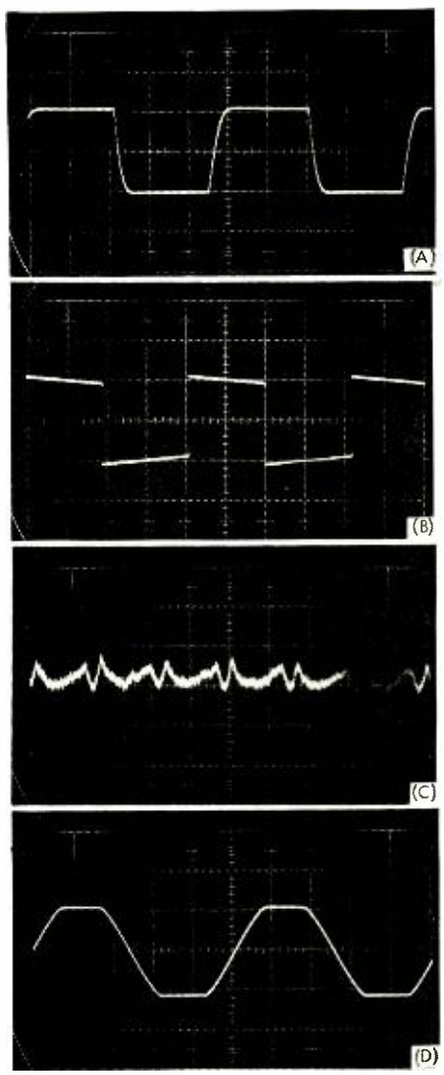


Fig. 5. Performance as shown by scope display: (A) 10 v/cm, 10 μs/cm, 20 kc; (B) 10 v/cm, 5 ms/cm, 50 cps; (C) 10 mv/cm, 5 ms/cm, zero signal hum and noise; (D) 20 v/cm, 0.2 ms/cm, 1 kc clipping. All photos of channel 2 loaded with 16 ohms. Asymmetry of square waves in generator.

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THE DYNALIZER

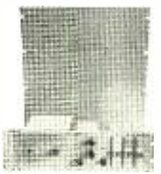
the Psycho-acoustic way to achieve a bright, full bodied easy-to-listen-to, easy-to-perceive station sound. The Dynalizer contours your station's frequency response to fully utilize the listening capabilities of your audience. Makes your station sound really big, big, big even on the smallest pocket receivers.



THE CONAX

the world-accepted way to control high frequency spillovers in FM due to preemphasis. Lets your station maintain real high levels even with brass and crashing cymbals and still avoid FCC citations.

THE REVERBERTRON



the new compact reverberation system which gives your station that real big voice. With the Reverbertron you can have that Carnegie Hall effect as close as the gain control on the Reverbertron. And there's the added plus of an increase in apparent loudness of your station sound due to reverberation, as originally described by Dr. Maxfield.

For complete details on psycho-acoustic sound that sells write to Fairchild — the pacemaker in professional audio products.

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RECORDING EQUIPMENT CORPORATION
10-40 45th Ave., Long Island City 1, N.Y.

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to achieve equivalent response and performance.

I will be happy to assist with any problems, and I welcome any suggestions or criticisms.

PERFORMANCE DATA

A. *Frequency and power response:* Both channels driven, 0 db at 1 kc
16-ohm loads:
1 watt/channel +0, −1 db 4 cps to 94kc
10 watts/channel +0, −1 db 5 cps to 62 kc
15 watts/channel +0, −1 db 6 cps to 42kc clipping at 16 watts
8-ohm loads:
15 watts/channel +0, −1 db 5 cps to 43kc
20 watts/channel +0, −1 db 6 cps to 33kc clipping at 21 watts

B. *Risetime:*

Input:

square wave, 10kc, risetime 100 nsec.

Output:

15v, peak-to-peak, risetime 2.5 μsec.

C. *Output Impedance:* less than one-half ohm

D. Signal-to-noise ratio: 10 watts into

D. *Signal-to-noise ratio:* 10 watts into 16 ohms, 70 db

E. *Harmonic distortion:* Both channels driven, 10 watts/channel into 16 ohms less than 0.6%, 20 cps to 20kc

F. Zero signal hum and noise less than 7 mv peak-to-peak with 16-ohm loads.

Much better performance at high frequencies may be expected with parallel operation of the output stages, under high signal conditions.

Test equipment used in testing of stereo amplifier:

Hewlett-Packard 200CD audio oscillator, 400D VTVM, 330B wave analyser; Tektronix 543B, L unit Oscilloscope/Plug in, 105 square wave generator.

I did not have equipment to make a meaningful test for IM distortion, and and I did not have time to use the wave analyser for more than a single test run. But the figures on harmonic distortion are promising of good performance. Æ

PARTS LIST

Amplifier
(two of each part needed for stereo)

C_1 15μf, 25v (Sprague TE 1205)
C_2 200μf, 10v (Sprague TE 1119.6)
C_3 20μf, 50v (Sprague TE 1305)
C_4 200μf, 10v (Sprague TE 1119.6)
C_5 0.1μf, 200v (Sprague 192P10492)
C_{out} 1000μf, 50v (Sprague TVL 1338)
C_f (see text) 68pf, 10%
(Sprague 10TS-Q68)

D_{1-3} 1N456A (T.I./Sylvania)

Q_1 2N3250 (Motorola)
Q_2 2N2270 (RCA)
Q_3 2N2270 (RCA)
Q_4 2N3133 (Motorola)
Q_{5-8} 2N3055/2N1488 (RCA)

R_5 200k (Bourns E-Z-Trim 3068P-1-204)
$R_{13, 14, 16, 17}$
0.47-ohm, 2w, 5%, (IRC type BWH)
all other resistors ½w, 5% composition, except R15, 1w.
Transistor sockets Elco type 3305
Heat sink for $Q_{5, 6}$ and $Q_{7, 8}$ one sink for each series pair of transistors (Delco 7281366)
Heat sinks for $Q_{3, 4}$ Wakefield NF 207

Power Supply

$C_{1, 2}$ 33v supply 4500μf, 50v (Mallory CG452U50D1)
51v supply 3450μf, 75v (Mallory CG3451U75D1)
C_1 62v supply 2250μf, 100v (Mallory CG2251U100D1)
C_2 62v supply 3450μf, 75v (Mallory CG3451U75D1)
D_{1-6} MR1032 (Motorola)
IN1124 (Mallory)
D_z 33v supply 1N3032B (Mallory 1w, 5%)
51v supply 1N3037B (Mallory 1w,)
62v supply 1N3039B (Mallory 1w,)

$F_{1, 2}$ 33v supply ½A, slow (Buss MDL)
(Littelfuse 3AG Slo-Blo)
51v supply 1A, slow
62v supply 2A, slow
$F_{3, 4}$ 33v supply ¾A, fast
(Buss AGX or AGC)
(Littelfuse 8AG or 3AG)
51v supply 1A, fast
62v supply 2A, fast
Pilot lamp 28V, 0.04A
(Dialco 7538 lampholder)
(Dialco 39-28-1471 lamp)
Q_{p1} 2N1544/2N277
(Motorola TO-3/TO-36)
Q_{p2} 2N2869 (RCA TO-3)

R_b 33v: 1k, ½w 51v: 2k, ½w 62v: 2.7k, ½w (all 5%)
R_d 33v: 120, 1w 51v: 560, 2w 62v: 820, 2w

Transformer Power

33v supply
(Stancor RT 202)
(Knight (Allied) 62G332)
(Triad F-61-U (30V tap))
51v supply
(Signal Transformer Co. MV-2)
(Stancor P-6377 (two in series))
(Knight 62G353 (two in series))
62v supply
(Signal Transformer Co. 56-4)
(Signal Transformer Co. MV-4)
(Direction 28-T-4)
Heat sink for Q_{p1} and Q_{p2}
(Delco 7281366)

All of the power transistors should be insulated from the heat sinks, and the use of heat sink compound, such as Dow-

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Corning 340 is highly recommended. This compound is available from Allied Radio, (as are almost all of the components in the lists) in two c.c. packages, for 25 cents a package. Allied part number 8 E 818. Two packages will be plenty.

Equivalents to the listed parts may be safety used, providing they are not used over recommended ratings.

Transistors have been chosen to give maximum performance consistent with reasonable, and usually minimum, cost.

Friends have recommended the use of Sylvania "Mite-T-Breakers" in place of fuses F3, 4. I have had no experience with them, but they seem to be very convenient. I prefer fuses, however, because they *don't* reset automatically. If fuses are blowing, one should be finding out why.

The Delco heat sinks are pre-punched, and painted, and mount two transistors of either TO-3 or TO-36 outlines, or both.

DYNAGROOVE

(*from page 77*)

with respect to the listener: the direct sound from the loudspeaker and the generally reflected sound. The acoustical characteristics of the average room in a residence accentuates the low-frequency response. The general run of direct radiator loudspeakers exhibit increased directivity with increase of frequency. The combination of the acoustical characteristics of the room and loudspeakers conspire to produce an accentuation in the low-frequency response as perceived by the listener. The relative response at normal listening distances derived from the dynamic average of the direct and generally reflected sound for the case of music reproduced in a room in a residence is shown in *Fig.* 11.

The loudness-*versus*-loudness level[19, 20] must also be considered in the transition from the concert hall or studio and the small room in the home. A scale showing the relation between loudness in sones and loudness level in phons is shown in *Fig.* 12.

From the preceding discussions, the main equalizations are due to a drop in the level of about 20 decibels which can be deduced from *Fig.* 10 and the increased low-frequency response from the acoustics of the room of *Fig.* 11. This process leads to a first approximation of the equalization which is required.

To summarize, there are six characteristics that must be considered in the reproduction of sound in a room in the home: The peak level of sound reproduction in a residence, the ambient noise level in a room in a residence, the spectrum of the ambient noise, the loudness versus loudness level, the response frequency characteristics of the ear, and the reverberation characteristic of the average room in a residence.

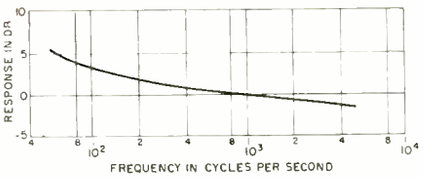


Fig. 11. The relative response derived from the dynamic average of the direct and reflected sound reproduced in a residence.

Employing the first approximation equalization derived as outlined above, the next consideration is any indicated modification of these characteristics by use of the subjective tests which will provide the listener in his home environment with sound reproduction which exhibits the highest order of artistic and subjective resemblance to that of the corresponding condition in the concert hall.

TO BE CONCLUDED

[19] S. S. Stephens, "The Measurement of Loudness," *Journal* of the Acoustical Society of America, Vol. 27, No. 5, p. 815, 1955.

[20] J. P. A. Lochner and J. F. Burger, "Pure-Tone Loudness Relations," *Journal* of the Acoustical Society of America, Vol. 34, No. 5, p. 576, 1962.



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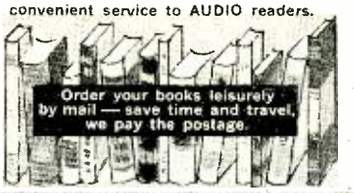
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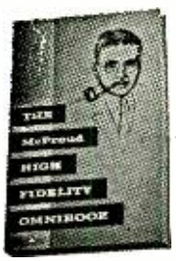
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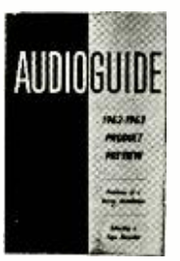
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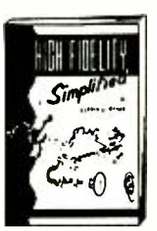
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Herman Burstein

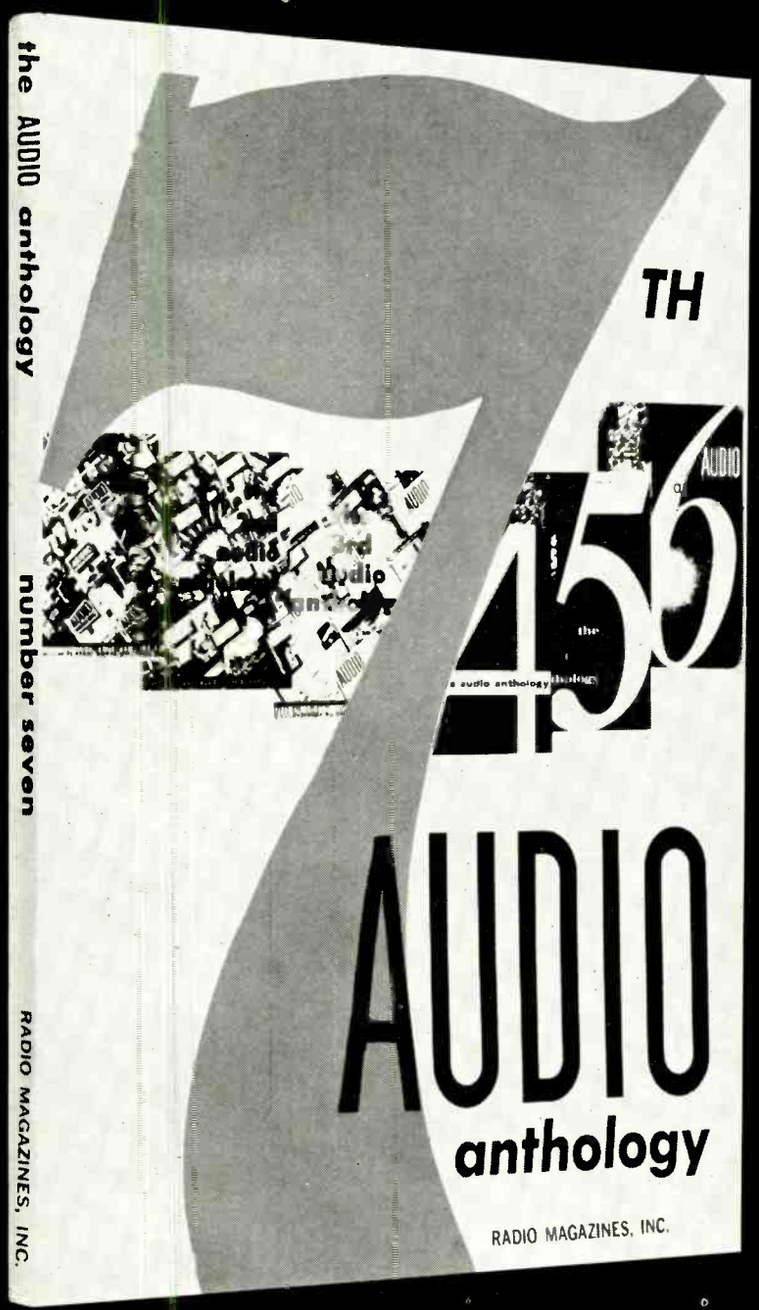


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AUDIOCLINIC

(*from page 4*)

claims that this amplifier will not be damaged under "no-load" conditions, you should take precautions to avoid operating the amplifier unloaded.

The Need for Tone Controls

Q. In this day and age, with amplifiers improving all the time and speakers are better than ever, do we really need tone controls? Nario Brenes, Brooklyn, New York.

A. Indeed, we need tone controls on our home music reproducing equipment. One area which has not improved and is not likely to do so is room acoustics of the average listening room. Some rooms are so bright that highs must be reduced for comfortable listening; some rooms are "dead" and highs must be boosted. Some rooms have standing waves which greatly reduce low-frequency response and lows must be boosted. Other listening rooms call for decreased low-frequency boost.

Recordings vary, partly because of the room acoustics of the hall in which the material was recorded and partly because of the wishes of the A & R men in the recording companies. Variations in tonal quality of various recordings can be compensated for in large measure through the use of tone controls.

Finally, and probably most important of all, one listener may prefer one kind of response, and another listener may prefer another kind of response. Each listener's taste can be accommodated through the use of tone controls.

I use tone controls flexibly. If the material being heard seems to call for more or less bass or treble, that is what it gets. As far as I am concerned, the "flat" positions of tone controls are only for reference and not to be used slavishly, regardless of circumstances. Æ

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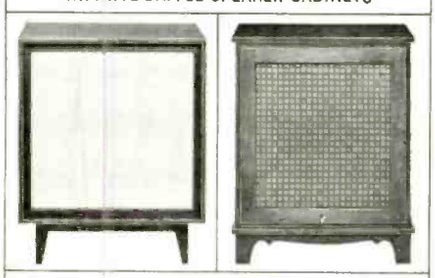


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Industry Note . . .

• **Jensen Hi-Fi Speaker Line Withdrawn From National Mail-Order Catalogs.** The Jensen hi-fi speaker line will be missing from big-three national mail-order catalogs (Allied, Lafayette, and Radio Shack) this Fall, it was announced by Ralph P. Glover, vice president and general manager of the company. The move is part of a program to increase the effectiveness and stability of local hi-fi dealer operations, according to Mr. Glover. While the line will be included in some catalogs for local and limited area promotional purposes, the accent in the Jensen distribution system will be on local store operations. The company has not fair-traded the line because of inconsistencies in state laws. However, the company will regard merchandising practices which are inconsistent with its program, or which do not result in profitable sales by a Jensen dealer, as a basis for terminating a relationship whenever it appears necessary to conserve the market for cooperating local dealers.



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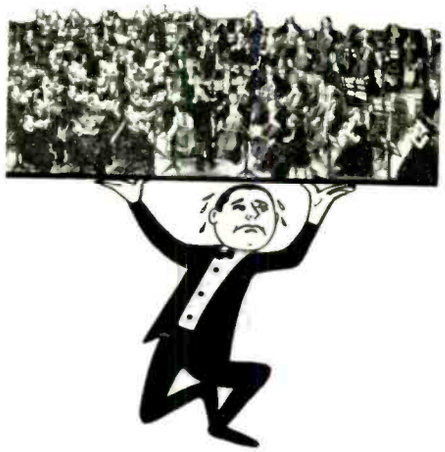
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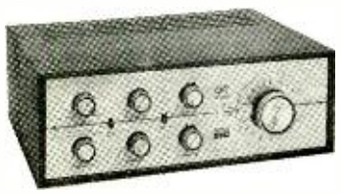
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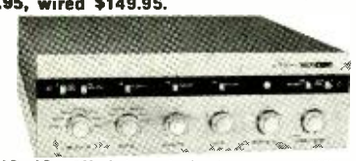


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ADVERTISING INDEX

Acoustech, Inc.	6
Acoustic Research, Inc.	5
Acoustical Manufacturing Co., Ltd.	4
AKG of America	74
Altec Lansing Corporation	34, 35, 69, 71
Artisan Organs	86
Audio Applications, Inc.	93
Audio Bookshelf	90
Barker & Williamson, Inc.	82
Benjamin Electronic Sound Corp.	27
Bozak	93
British Industries Corp.	3
Chancellor Electronics, Inc.	79
Classified	92
Concertone	64
Crown International	92
Dynaco, Inc.	11
Eastman Kodak Company	31
EICO Electronic Instr. Co.	94
Electro-Voice, Inc.	Cov. IV, 1
Electro-Voice Sound Systems	93
Elpa Marketing Industries	76, 77
Empire Scientific	41, 42
Fairchild Recording Equipment Corp.	72, 88
Finney Company	94
Fisher Radio Corp.	9
Gotham Audio Corporation	78
Garrard Sales Corp.	3
Harman-Kardon, Inc.	13
Heath Company	7
Hi Fidelity Center	93
International Electroacoustics, Inc.	94
Jensen Manufacturing Company	45
Kenwood Electronics, Inc.	83
KLH Research & Development Corp.	73
Lafayette Radio	75
Lansing, James B., Sound, Inc.	63
LTV University	15
3M Company	38, 39
McIntosh Laboratory, Inc.	37
Multicore Sales Corp.	93
North American Philips Co.	12
Neat Onkyo Denki Co., Ltd.	87
Pickering & Company, Inc.	17
Scott, H. H., Inc.	Cov. II
Sherwood Electronic Laboratories, Inc.	18
Shure Brothers, Inc.	25
Syncron Corporation	86
Tandberg of America, Inc.	89
United Audio	81
University Loudspeakers	15
UTC Sound Division	28, 29
Viking of Minneapolis, Inc.	84, 85
Weathers Division of TelePro Industries, Inc.	Cover III
Webcor, Inc.	87

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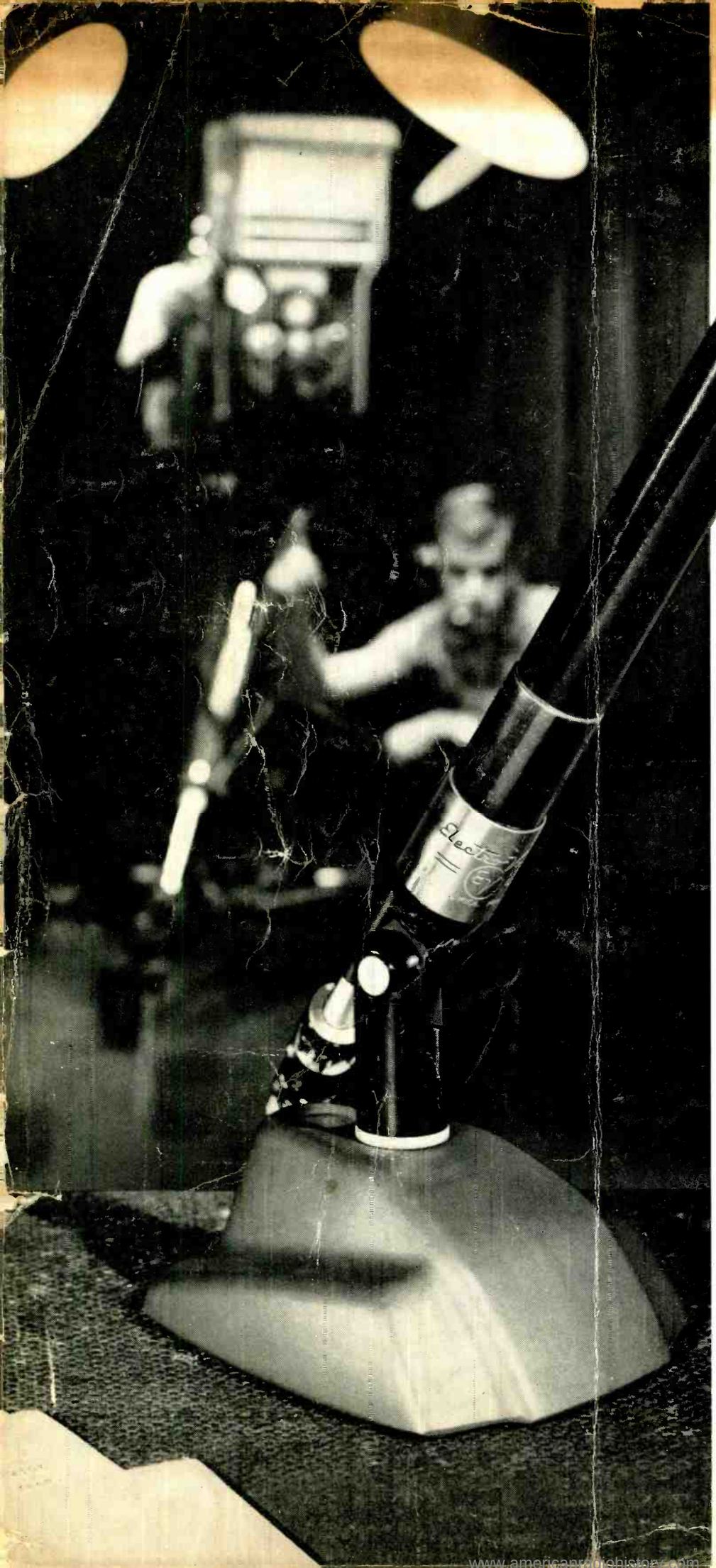
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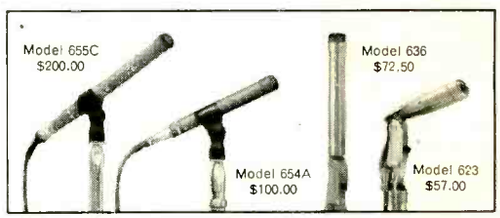
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