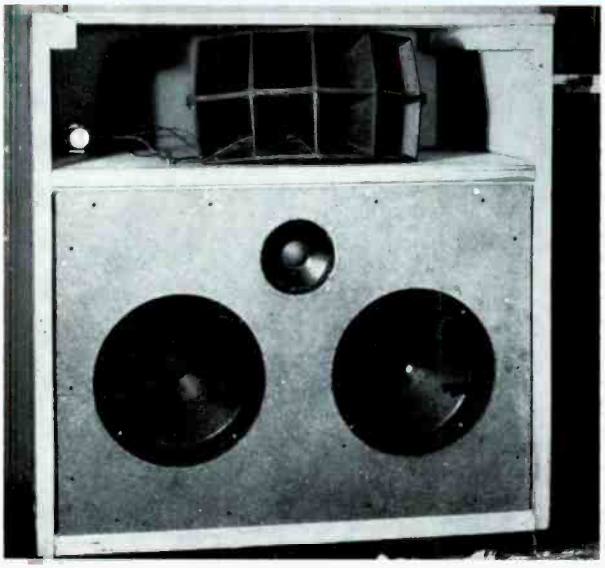
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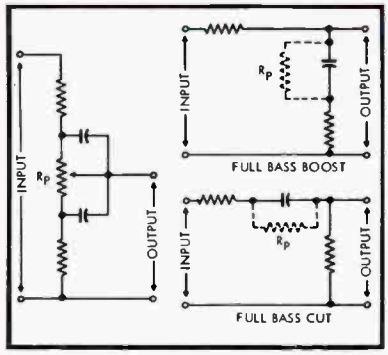
ENGINEERING MUSIC SOUND REPRODUCTION

MARCH, 1956

50¢



No one is ever satisfied with his speaker system for more than a year, it appears. One reader tells us how he improved his. See page 22.



The how and why of bass and treble tone controls is told in this chapter of "Sound"—page 36.

JAZZ BY JEAN—A new column about records

HOW LOUD IS SOUND?

THE ARTISTIC INTEGRITY OF THE RECORD

TRANSFORMER DESIGN FOR ZERO-IMPEDANCE AMPLIFIERS

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MARCH, 1956 VOL. 40, No. 3
Successor to RADIO. Est. 1917.

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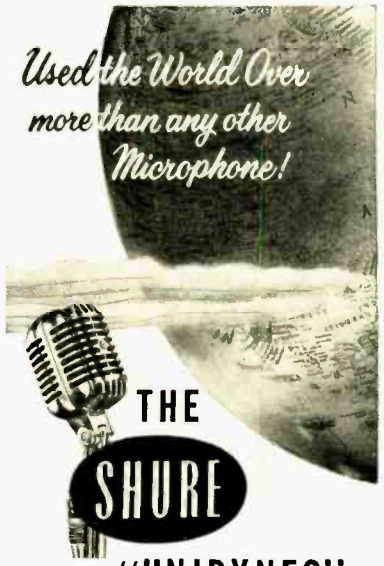
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Special Representative—
H. Thorpe Covington,
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AUDIO PATENTS

RICHARD H. DORF*

A MONTH OR SO AGO I telephoned Mr. Henry E. Sharpe to get some details on a new patent which had been issued to him and looked interesting for this department. I didn't know Mr. Sharpe,[1] but he turned out to be not only a patent attorney but also Vice-Chairman of the Committee on Public Relations of the New York Patent Law Association. Our conversation turned to patent matters in general and it developed that Mr. Sharpe is knee deep in a campaign to help the Patent Office recruit new patent examiners. It appears that the shortage of them is largely responsible for the fact that it takes three years or more for a patent application to be processed. Mr. Sharpe whetted my interest in this subject and I pass on some of the information to you. Many AUDIO readers are undoubtedly eligible for examiner positions and may be interested; for those who are not, I purvey herewith in addition a little background on the way the P. O. runs, which should be of interest because of the very strong influence of that government activity on technological progress in this country.

To begin with the want ad, you, too, can be a patent examiner if you have a college degree (even a recent one) (a) in any field of engineering or applied science, or (b) with a chemistry major including 26 hours in chemistry, or (c) with a physics major and 21 semester hours in physics, or (d) with any other major that included either 40 combined semester hours in engineering, chemistry or physics, or 28 combined semester hours in chemistry and physics.

Pay begins at $4345 a year and after six months you rise to $4930. Merit raises after another year and another 18 months can be to $5440 and $6390 yearly, respectively. Two and a half to three years later if you merit it, you can get up to $7570. Further advancement, says the Patent Office, can take you up to $13,760 a year. You get 13 working days of vacation each of the first three years, 20 working days after that, and if you reach the 15-year mark, 26 working days are yours to spend in pleasurable pursuits every summer. If you are after an advanced degree, the authorities point out that there are seven schools in Washington which give suitable evening courses.

There is no examination for the job if you fulfill any of the above requirements. Just apply to the Commissioner of Patents, Washington 25, D. C., and presumably if your qualifications look interesting, you will be sent instructions.

Some idea of the need for new examiners (300 are wanted in 1956) can be had from the fact that as of last April there were 138,000 applications in the Office awaiting action by examiners, as well as 80,000 waiting for responses from applicants. This backlog, which exists all the time, is why applicants have to wait many months for each Office action and have to suffer the results of incomplete protection on their inventions and developments.

* *Audio Consultant, 255 W. 84th St., New York 24, N. Y.*

[1] Nor, I think, did he know me. Take that—and *that*, ego!

Progress of an Application

When you want to get a patent on an invention, you or your attorney must file an application in prescribed form, which includes a complete description of the invention, one or more drawings where necessary, an oath to the effect that you are the sole and original inventor, and so on, and the fee.

After routine processing, your papers reach an examiner, whichever one it may be assigned to within the one of the 66 Divisions into which your invention is classified. The examiner studies your application and claims, searches U. S. and foreign patents, and the literature to see if he can find any evidence that someone has invented "your" gadget first or has come close enough to rule you out as the first inventor. The usual result of this is a so-called Patent Office "action" citing prior art to show why at least some and perhaps all of your claims cannot be allowed. This is transmitted to your attorney.

Usually, you (if you are not a guardhouse lawyer) immediately concede that the examiner was right and are ready to drop the whole thing. However, your attorney is not so ready to call it quits, for he knows that between the black and the white there is gray—and furthermore, an examiner can be entirely mistaken and doesn't mind being told so—politely. So, sometime within six months after receipt of the action, he drafts a response which may point out where the examiner is wrong and why certain of the rejected claims should be allowed, or he may redraft claims to eliminate technical objections, or he may add new claims, taking care that nothing added strays from the invention as originally described. Again the examiner considers the application, this time as amended. He may accept and allow some of the changed or added claims, or he may again disallow some or all claims, depending on what he believes to be the proper interpretation of such prior art as he has found. This interchange between attorney and examiner can go on indefinitely, theoretically, until both are satisfied. In fact, it is rare that more than three actions are taken by the examiner, after which the patent is either issued with the unrejected claims or is abandoned.

At least one fly can invade the ointment during this processing period—an interference. This is declared when two applications in process at the same time are thought to conflict. It is then up to the two applicants to prove priority of invention. Interferences can be declared only while both applications are in process; an application which has resulted in an issued patent is considered to be anticipation of any application granted and cannot be attacked except through the courts in an infringement proceeding. So the longer your application takes to become a patent, the longer you are open to interferences from others who may have had the same idea as you a little later. And the fewer examiners on the job, the longer your application takes.

You may, of course, disagree with the examiner's final rejections of some or all

(*Continued on page 65*)

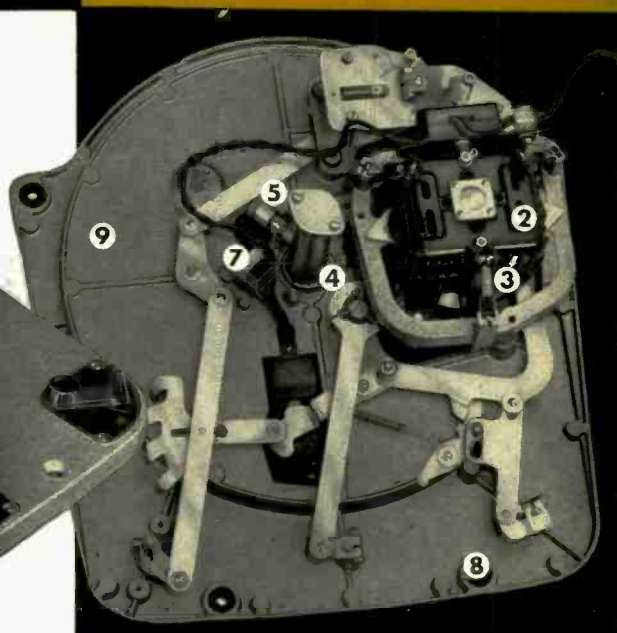
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3 FREE-FLOATING ISOLATED MOTOR MOUNT: A newly developed GARRARD principle, whereby the entire motor is suspended in air by two sets of counterbalancing tension springs. This unique mounting eliminates even the barest possibility of vibration being transferred to the unit plate.

4 NOISELESS MAIN SPINDLE: Rotates on single, specially designed frictionless semi-elliptical bearing of phosphor bronze which eliminates noise and rumble and is simple and inexpensive to check and replace.

5 BUILT-IN PRESSURE LUBRICATING SYSTEM: Oversized grease-housing permanently mounted on main spindle to insure continuous, proper lubrication at all times. Knurled knob, easily accessible from top of unit for turning, forces additional lubricant into spindle, when required.

6 VARIABLE SPEED CONTROL: Simple, foolproof eddy current brake permits instantaneous variation of all 3 speeds. Positive action at all times through permanent magnet, which interacts with revolving metal disc. No friction, no loss of efficiency.

SPEED SAFETY LOCK: Makes it mandatory to shut unit off before switching speeds. An important safety device, preventing jamming of idlers and operating mechanism.

7 RESISTOR-CONDENSOR NETWORK: Eliminates shutoff noise, which is normally induced through pickup to loudspeaker.

PERFECTED TURRET-DRIVE MECHANISM: Large, true pulleys actuate oversized live rubber interwheel, which is mounted on ball bearings and retracts upon shutoff.

SHUTOFF BRAKE: Stops free turntable revolutions when unit is switched off.

8 EXCLUSIVE MOUNTING—SUSPENSION SYSTEM: Permits unit to be mounted firmly to motorboard in fixed relationship to tone arm. Entire motorboard (including turntable and tone arm) is then spring-suspended on base. Special conical Garrard springs and other hardware provided.

9 HEAVY UNIT PLATE: Entirely die-cast and aluminum.

SPECIFICATIONS: Voltage: Dual range, 100 to 130 and 200 to 250 volts, 50 cycle only available. **Wow:** Less than 0.2% **Flutter:** Less than 0.05%. (Goumont—Kalee Wow and Flutter Meter Type 564) 3000 cycle constant frequency records at 33⅓, 45 and 78 rpm. **Rumble:** Virtually non-existent. **Cabinet space required:** 16" back to front x 13¾" wide x 2½" above (excluding pickup) and 3½" below top of motorboard. **Weights:** Net 16 lbs., Gross 20 lbs.



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LETTERS

Biflex Speakers

SIR:

In his letter published in AUDIO of January, 1956, Mr. H. A. Hartley criticizes my article in the November issue describing Biflex loudspeakers, and claims that the system of cone compliance described by me is his invention dating back to 1938. United States Patent No. 1,846,937 issued to A. V. Bedford in 1932 (six years before Mr. Hartley's invention date) discloses as Claim #1: "A diaphragm comprising a plurality of sections of successively larger area, and coupling means for said sections comprising damping members connected to adjacent sections." Mid-compliances and the use of viscous materials are disclosed in United States Patent No. 1,876,831 issued in 1932 and No. 2,071,829 issued in 1937. I believe these patents fully describe the systems that Mr. Hartley claims to have invented in 1938. Our study of the U. S. patent structure did not reveal inventions in this field by Mr. Hartley.

The refinements of application and design engineering using these compliance principles as an extension of the art was discussed in my article. The analog which appeared in this article was simplified for the purpose of explaining in simple, basic terms the actions of the various components of the moving system of the Biflex loudspeaker. The text covered the various elements, but although Mr. Hartley finds fault with the mathematics, actually no mathematical analysis whatever was given. More important, he apparently missed the explanation which treats the purpose of the mechanical resistance on the edge compliance of the cone (RM_s and C_s). The addition of what he refers to as "goo" on the edge compliance does not perceptibly change the resonant frequency. As was explained in my article, the only function of RM_s, which is the mechanical resistance termination in the form of a viscous solid layer, is to absorb the energy travelling in the cone and prevent its reflection. When such reflections are permitted to occur, serious irregularities will result due to standing waves in the cone. Edge compliance damping has been used by many manufacturers in the United States for at least the past decade to prevent this condition. This important feature of design seems to have been overlooked by Hartley, as has the need for protecting the magnetic gap and voice coil from ferrous particles and dust.

The voice-coil compliance suggested by Mr. Hartley for improved high-frequency response is a well known expedient which proved unnecessary in the Biflex design, for the benefits received therefrom would, in my opinion, have been more than offset by loss in efficiency and other considerations.

The wide acceptance of the new Biflex line of Altec Lansing speakers by the public and praise from critical listeners seem ample testimony for the soundness of design and exceptional quality of these speakers.

ALEXIS BADMAIEFF,
Altec Lansing Corporation,
9356 Santa Monica Blvd.,
Beverly Hills, California.

Gremlins Again

SIR:

Several significant errors appear in the schematic wiring diagrams presented in my article "High-Quality Dual Channel Amplifier" in the January issue. In the low-pass section of the high-impedance dividing network, (*Fig.* 2), the final capacitor in the three-section R-C network is .00025 instead of .0025. In the power amplifier the portion of the cathode resistor of the 6J7 tube which is not bypassed (*Fig.* 3) is 33 ohms rather than 33,000 ohms. The input coupling capacitor is 0.1 μf. These errors do not appear in the original circuit diagrams supplied.

It might be worth mentioning that the power amplifier (*Fig.* 3) is easily modified to accommodate type 6550 tubes. The same output transformer is ideally suited to this purpose. The power output is doubled for the same distortion. Circuit changes include employment of a different cathode bias resistor and a screen voltage dividing network with a bypass capacitor, and increasing the power supply voltage by using a capacitor input filter (*Fig.* 4).

CHARLES W. HARRISON, JR.
Commander, USN,
1401 N. Pocomoke St.,
Arlington 5, Virginia.

(*Several readers noticed these errors.* ED.)

SIR:

An unfortunate draftsman's error in my article "Transistor Tips and Techniques" in the February issue rendered *Fig.* 5

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"Scotch" Magnetic Tape solos in "The Benny Goodman Story"



Star of the Universal-International Technicolor Film and the NBC-TV SHOW "TONIGHT"—Steve Allen in the role of Benny Goodman

IT'S STEVE ALLEN not Benny Goodman you'll *see* in the new Universal-International Technicolor Film, "The Benny Goodman Story". But the music you'll *hear* is by the "King of Swing" himself—as originally recorded for this picture on "SCOTCH" Magnetic Recording Tape.

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meaningless. First, the two points *R* and *S* were interchanged. Second, the horizontal axis should have been labeled COLLECTOR VOLTAGE instead of Supply Voltage, and the vertical axis should have been labeled COLLECTOR CURRENT instead of Collector Voltage.

This should clear up any confusion, and should allow readers to observe the similarities between the transistor characteristic curve families and those for vacuum tubes.

PAUL PENFIELD, JR.,
752 Lakeside,
Birmingham, Michigan.

(*We know of another one, too. On the cover of the February issue, the word* DIRECTION *should have appeared instead of the word Distortion alongside the diagram of the magnetic pickup.* ED.)

COMING EVENTS

March 19–22—IRE National Convention. Waldorf-Astoria Hotel and Kingsbridge Armory, New York.

April 10–12—Radio Electronic Component Manufacturers Federation Show, Grosvenor House, London, England.

April 13–15—The London Audio Fair 1956. Washington Hotel, Curzon St., London, England.

April 16, 18, 19—Broadcast Engineering Conference, in conjunction with the 34th annual Convention of the National Association of Radio and Television Broadcasters. Conrad Hilton Hotel, Chicago.

April 23–24—New England Radio-Electronics Meeting, "Stocktaking of Electronic Progress." Sheraton-Plaza Hotel, Boston, Mass.

April 29–May 4—79th Convention of the Society of Motion Picture and Television Engineers, Hotel Statler, New York City.

April 23–May 6—British Industries Fair. Earls' Court, London, England.

May 1–3—Joint Electronic Components Conference, I.R.E., National Bureau of Standards, Washington, D. C.

May 21–24—Electronic Parts Distributors Show. Conrad Hilton Hotel, Chicago, Ill.

June 17–23—Second International Congress on Acoustics. Registration at Mass. Inst. of Technology, Cambridge, Mass.

June 18–29—Special Summer Program in Switching Circuits, M. I. T., Cambridge, Mass.

Aug. 21–24—WESCON, I.R.E. Convention and West Coast Electronic Manufacturers Association show, Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 17–21—Second "Feria de Alta Fidelidad," Mexico, D. F. Sponsored by Asociacion Mexicana de Impulsores de Alta Fidelidad. For information, write Mario R. Aguilar, Lopez 43, Mexico 1, D.F.

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**with hysteresis motor*

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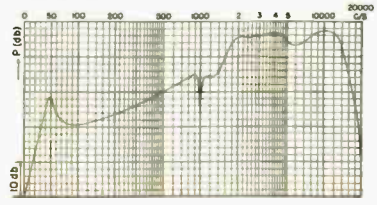
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This sample characteristic curve has been measured in an anechoid chamber without a baffle—and is far below the maximum performance characteristics possible. The low note reproduction will extend linearly down to the fundamental resonance of the speaker with a suitably dimensioned enclosure. Send for recommended enclosure specifications.



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ABOUT MUSIC

HAROLD LAWRENCE*

Handel With Care

THERE IS NO QUESTION that Bach and Handel were the dominant figures in the late Baroque era. Yet, in the representation given the two composers in concerts, publications and recordings, there is a staggering preponderance in favor of Bach.

Most of Bach's works are readily available in many editions. In the concert hall, no organ recital series would be complete without the inclusion of at least one entire program devoted to Bach's compositions, not to mention a complete Bach cycle. Chamber orchestras regularly perform the Brandenburg Concertos, the Suites, and the Violin and Clavier Concertos. Pianists and harpsichordists play the Partitas, English and French Suites, the *Italian Concerto*, the Toccatas and, of course, that keyboard bible, *The Well-Tempered Clavier*. No violinist worth his rosin would dream of omitting the Violin Sonatas (accompanied and unaccompanied) from his repertoire. The same can be said for the Cello Sonatas. And in churches of many lands, the Passions and the Mass in B Minor are familiar works.

This was not always the case. For nearly a century after his death, Bach was a dim figure out of the past in the eyes of all but a few musicians. One of these, Felix Mendelssohn, took more than a private interest in Bach's music and nearly singlehandedly brought about a Bach renaissance that eventually led to a full recognition of the composer's genius.

Recognition came to Handel early in life and lasted (particularly in England) until the present. But it was of a static nature. While Bach's first nineteenth-century champion, Mendelssohn, was busy reviving such masterpieces as the *St. Matthew Passion*, and later musicians and composers extended the public's appreciation to include the great scope of Bach's over-all production, nothing of the kind happened to Handel's music.

After nearly 200 years, the picture of George Frederick Handel (1685–1759) is still incomplete. He is known to music lovers by a limited number of works, and most of these in "arranged" forms. His arrangers have been nearly all conductors. Sir Hamilton Harty was responsible for the Suites from *Water Music* and *Royal Fireworks*; Sir Henry J. Wood modernized the Organ Concerto No. 9; Sir Thomas Beecham "suitened" *The Faithful Shepherd*; and Eugene Ormandy gave the Philadelphia Orchestra treatment to the Organ Concerto in D. Of original Handel, the most frequently-heard works are the Concerti Grossi, Op. 6, the Violin Sonata No. 4, the movement of the Clavier Suite in E subtitled, "The Harmonious Blacksmith," and some of the organ concertos. Apart from regular performances of *Messiah* and occasional hearings of *Judas Maccabaeus*, *Israel in Egypt* and a few other operas and oratorios (*Xerxes*, Handel's only comic opera and the setting for the famous *Largo*, was recently given a halfhearted revival in New York), the dramatic Handel is virtually unknown.

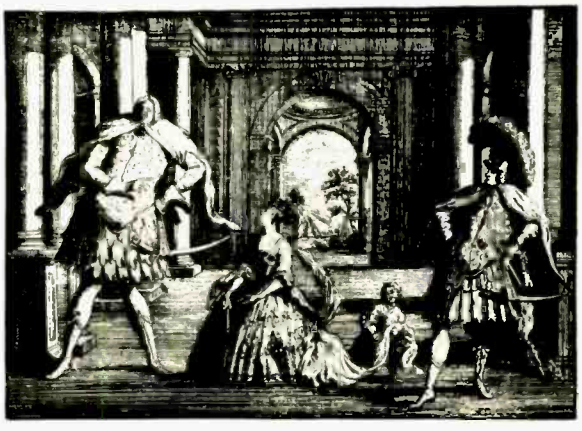
The curious fact is that while practically every note of *Messiah* is familiar to music lovers everywhere, no more than a few isolated arias and choruses remain from other operas and oratorios: "Where'er you walk" (*Semele*), "Alma mia" (*Floridante*), "See the Conquering Hero Comes" (*Judas Maccabaeus*) are some examples.

What, then, accounts for the almost universal neglect of the rest of Handel's vast output . . . the hundred cantatas, the dozens of unplayed operas and oratorios, and the large body of vocal, chamber, instrumental and church music? Have they simply failed to withstand the ravages of time or, as one critic put it, "Is Handel, like early nineteenth century silver, only second-hand and not antique?"

The answer has been offered that since his works were seldom performed more than once or twice during his lifetime, they were therefore quickly forgotten. By

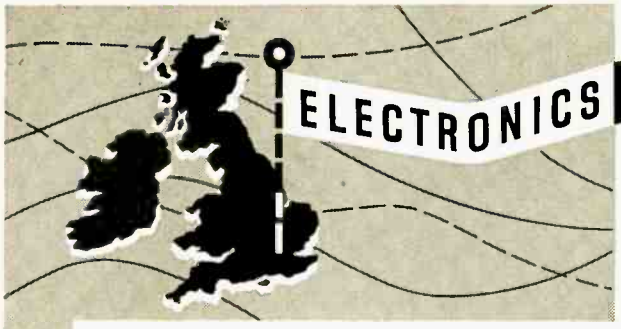
* 26 West Ninth Street, New York 11, N. Y.

—Bettman Archive



Caricature of three famous singers of the day in a scene from Handel's opera, "Julius Caesar" (c. 1724). From left to right: Caesar (Berenstadt), Cleopatra (Cuzzoni), and Marc Antony (Senesino).

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the same token, not many of Bach's works were repeated in public performance during his day, yet they are standard fare today. And, as for Schubert, some of that composer's symphonies were not played until years after he died: the Symphony in C ("Great") received its premiere in 1839 and the "Unfinished" in 1865, eleven and thirty-seven years following his death! In the case of Handel's operas and oratorios (the most flagrant omissions in the repertoire), there is a more plausible explanation.

When Handel came to London in 1710, opera was enjoying a great vogue. The accent was then on spectacles and star performers. Thus, in *Rinaldo*, Handel's English operatic debut, the sets included a "Chariot drawn by two Dragons," a "black cloud . . . fill'd with dreadful Monsters spitting Fire and Smoke," "Waterfalls . . . Thunder, Lightning, and amazing noises," and a "delightful Grove in which the Birds are heard to sing, and seen flying up and down among the Trees." Reviewing a performance of *Rinaldo*, Sir Richard Steele in the "Spectator" had some comments to make about the Birds: "The Sparrows and Chaffinches at the Hay-Market fly as yet very irregularly over the Stage; and instead of perching on the Trees and performing their Parts, these young Actors either get into the Galleries or put out the Candles. . . ."

In the face of all these diversions, nobody paid much attention to the libretto. Besides, it was in a foreign language which the average nobleman could not understand. But what did that matter when the cast included three of the finest Italian singers of the day? To these ingredients was added the fresh, vigorous spirit of Handel's music. Result: *Rinaldo* was an immediate success.

Operatic life in early Hanoverian England was strictly an offshoot of the continent—a copy of the Italian original, and a poor copy at that. Insipid libretti that passed muster on the boards of the Hay Market would have been hissed off the stage in Milan and Florence by a comprehending audience. While it was true that Handel later edited the texts of some of his oratorios, he seldom bothered with the books of his operas. Unfortunately, there was no da Ponte to work with in London. But even a passable libretto was ultimately at the mercy of an artificial operatic formula that is now thoroughly strange to modern ears.

Without the burden of costumes, sets and inept libretti, Handel's concert oratorios—with their emphasis on large choral forces—stood more of a chance of survival than the operas.

For all that, too many critics and conductors overlook a significant fact. During a period of more than *thirty years*, Handel devoted his major creative efforts to operatic writing. While it may be true that, in terms of artistic entities, these operas contain obsolete theatrical devices, should we therefore ignore them all, using only a few excerpts for "clear-the-throat" purposes in song recitals? Certainly Handel—and we—deserve more than this.

By now the reader is probably under the impression that a revival of Handel's neglected dramatic music would please the specialist more than the layman. Maybe the bits and scraps salvaged from these works represent all there is of lasting value. The facts would appear to support such a contention. After all, didn't Handel turn out one opera after another in rapid succession? How then could he have sustained a high level of inspiration? One instance is all that is needed to demolish this

(*Continued on page 64*)

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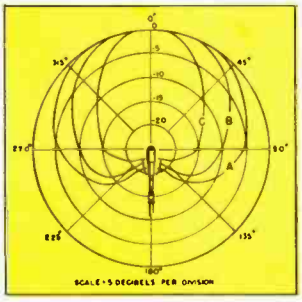
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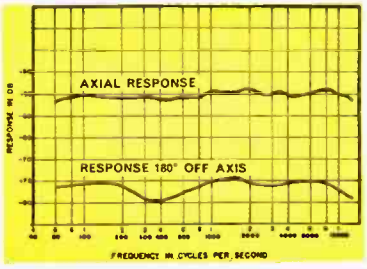
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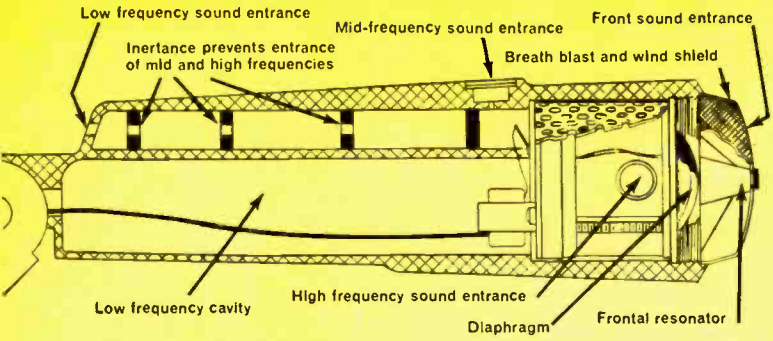
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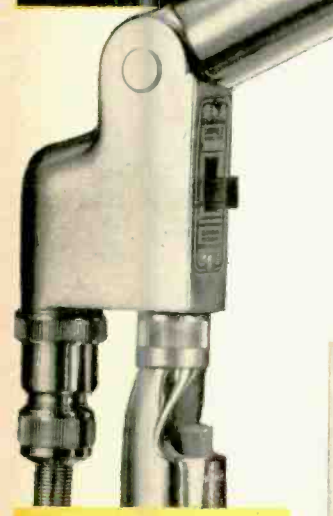
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EDITOR'S REPORT

SUCCESSFUL L. A. HI-FI SHOW

WHILE MOST OF THE AUDIO SHOWS that have been held throughout the country have been adjudged successful, it has become increasingly apparent that when an admission fee is charged, the quality of the attendance is considerably improved over that at the "free" shows. Whether this can be attributed to the possibility that people will place no greater value on a product than do those who are offering the product—and this assumes that the privilege of attending a show is, in fact, a "product"—or whether it just reduces the freeloaders who will go anywhere so long as it is does not cost them anything, still awaits determination.

The fact remains, however, that wherever an admission fee has been charged the people who come show a greater interest in the products offered, are more zealous in their desire to see everything there is to see, and are universally more courteous in their treatment of other visitors and the people who are manning the exhibits.

The first show at which an admission fee was charged was in Toronto last April—a city where there was no previous experience with an audio show which could serve as a precedent. Toronto is a large city, but it does not compare in population to either New York or Los Angeles, and some exhibitors blamed the 50¢ fee for what they considered a "low" attendance—which nevertheless reached some 5500. It must also be remembered that this was the first audio show in Toronto and only the second in Canada.

The Institute of High Fidelity Manufacturers opened its first industry show in Philadelphia last November, and an admission fee was again charged. For Philadelphia, the 17,000 attendance was exceptionally good, and after the show closed exhibitors were practically unanimous in praising the type of visitor that came.

Montreal and Toronto both had their second shows early this year, both charged fees, both had good attendance, and both had people who were seriously interested in audio.

The most recent show in Los Angeles—sponsored jointly by the I.H.F.M. and the West Coast Electronic Manufacturers Association—drew an attendance of nearly 20,000, reliably authenticated by the number of fifty centses paid in, and all of the people appeared to have a very real interest in what they came to see. From the exhibitors' standpoint the show was a huge success.

With the additional "kitty" to draw from, future IHFM shows will continue to be successful—not only in the numbers of people that attend, but also from the broader angle of spreading the story of hi-fi to more and more people each year, because the kitty will permit adequate publicity for the shows with the natural consequence of greater and more valuable attendance. We are wholeheartedly in favor of continuing the admission fee.

INNOVATIONS

Two new features appear in this month's issue—JAZZ BY JEAN, in which Jean Shepherd discusses a form of music which has as dedicated a following as the "classics"; and the "Be Your Own Record Critic" gimmick wherein you may acquire some LP records for writing your own criticism on one of them which will be selected each month by Edward Tatnall Canby. The former is on page 46, the latter on page 50.

Jean Shepherd, our newest acquisition as a contributor, is heard regularly on the air over WOR, New York, at the unlikely hours of 1:00 to 5:30 a.m. We think he talks about jazz in an interesting manner, and our own opinion of his brand of humor was substantiated in an article by Dr. Howard Decker in the November 28, 1955, issue of *The New Republic*. Dr. Decker claims that a new type of humor has developed on the radio over the past five years, one that is highly personal and which depends on humor of viewpoint rather than upon the joke or situation. Jean was listed among the top five humorists—as distinguished from comedians—on the radio. We commend his column to you, and suggest that if you live close enough to hear WOR you might derive a lot of entertainment from his droll wit.

TRUTH IN ADVERTISING—Cont'd.

In November of last year, M. Harvey Gernsback—president of Gernsback Publications, Inc., and editorial director of *Radio-Electronics*—sent a letter to his magazine's advertisers stating some regulations which were to go into effect with the beginning of the new year. Principally, these regulations provided that mail-order tube advertisers must state in their advertisements that they warrant the tubes offered to be new and unused, that they are not mechanical or electrical rejects, and that they are not washed and/or rebranded. We sincerely approve of Mr. Gernsback's stand, and commend him for it.

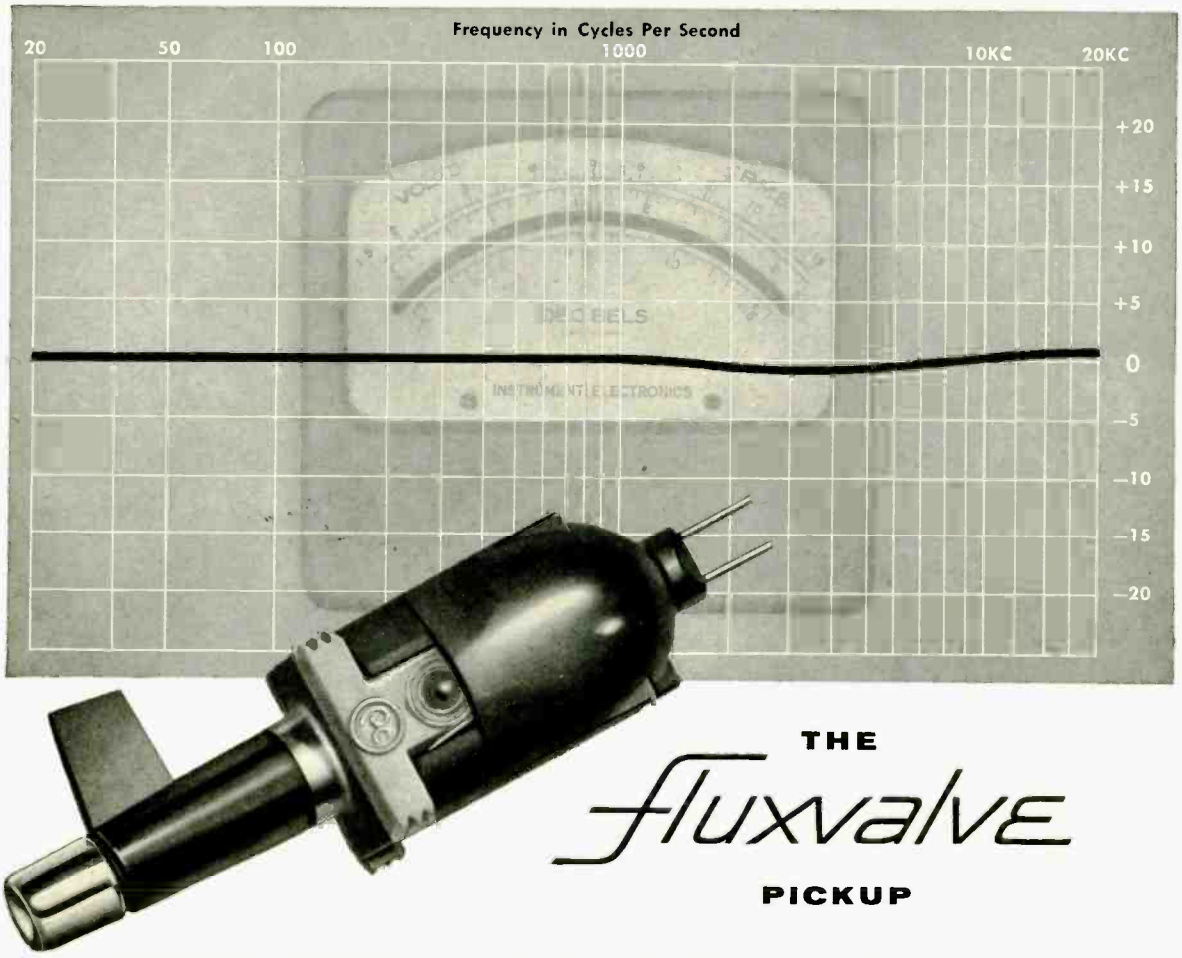
We commend him for two reasons—first, because we believe that those who buy from mail-order (or any other) advertising have a right to be protected from unscrupulous or downright false advertising; and second; because AUDIO has always been conscious of its obligation to readers with respect to the advertising pages. Over the past years, we have refused a few ads—some we have stopped after one appearance, others after numerous complaints. We do not permit the advertising of prices below the manufacturer's stated prices except in the case of *bona fide* closing out sales or for used equipment; we do not permit the description of a product in unsupportably enthusiastic terms; we insist upon knowing who the principal is when the ad is placed through an agency; in short, we try to make sure that the reader gets "only the facts, ma'am."

We think that our advertisers deserve a salute, too, because we have so rarely found any reason to question the products that they offer. Naturally, each one believes his products to be the best (if he didn't, he should set about to improve them so that they were) and he is entitled to say so. But it is to the everlasting credit of the greatest majority of the hi-fi manufacturers that they do so with fairness and honesty.

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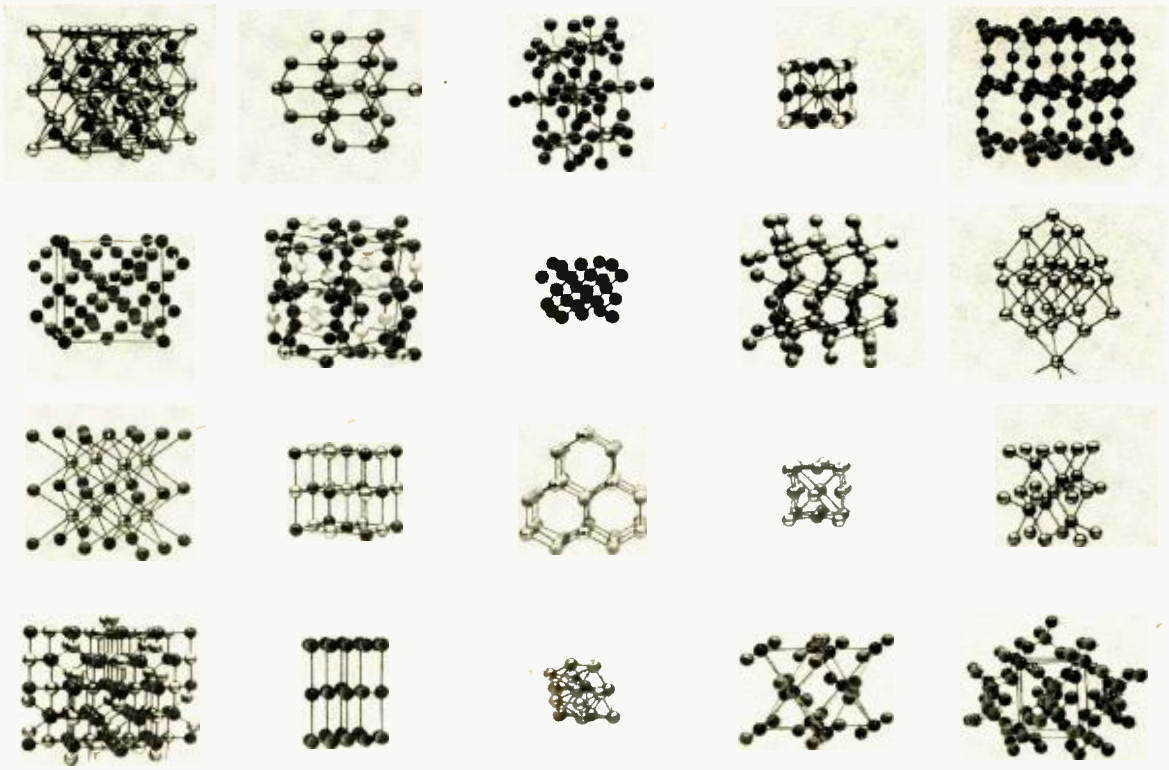
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How Loud is Silence?

Research has determined that the lower limit of our hearing threshold is close to the noise level generated by the movement of the air molecules. The possibility of reaching this sensitivity appears remote, however, because of the noises continually present within the ear itself.

CHARLES E. WHITE*

IN AUDIOLOGY, as in all scientific studies, a knowledge of measurable limits is always desirable and, if unknown, extensive efforts are made to establish their values. Considerable work has been done and numerous reports written concerning the maximum limit of sound tolerated by the human ear. The other limit, that of the threshold of hearing, also has received a great deal of attention and the trend in the past twenty years has been to push back this limit to lower and lower values. Consequently, there arises a healthy interest in what constitutes the theoretical minimum sound field which might be distinguished by the ear.

Calculation of Brownian Motion

The minimum sound field which could be distinguished by the ear is that intensity which just exceeds the Brownian movement of the particles of air. Through the work of a number of scientists there are available considerable data relating to the presence and detection of the absolute minimum field. In the forefront appear the references to the theoretical limit of aural acuity as discussed by Sivian and White[1] in 1933.

Employed in their dissertation was a relationship between the energy generated by thermal agitation, or the Johnson effect, and the energy capable of being propagated, or detected, by a piston source within an infinite baffle, which is used as an analogy for the ear.

$$\text{Thermal Energy} = 4KTR \times df$$

$$\text{Received or Propogated Energy} = (S \times P_f)^2 \times df$$

where K is Boltzman's constant,

T is absolute temperature Centigrade,

R is the resistance component of the impedance across which is developed thermal agitation,

P_f is the thermal-acoustic pressure,

S is the area over which P_f is developed.

From these relationships is expressed an equation:

$$(S \times P_f)^2 \frac{df}{R} = 4KT \times df \qquad (1)$$

where R is denoted as the acoustic radiation resistance at the frequency df. If S is considered to be a disc, equation (1) becomes

$$(\pi a^2 P_f)^2 \frac{df}{R} = 4KT \times df \qquad (2)$$

By reference to Rayleigh[2], the reaction of air to the displacement of a disc in an infinite baffle is represented in part by a frictional force which is proportional to the radius of the disc and the displacement of the disc surface and inversely proportional to wavelength.

From the equation for this frictional force, the radiation resistance may be determined, and when substituted into equation (2), the thermal acoustic pressure becomes

$$Pf = \left| \frac{4KT\rho c}{a^2 \mu \pi} \left(1 - \frac{J_1(2Ka)}{Ka} \right) \right|^{\frac{1}{2}} \qquad (3)$$

where $J_1(2Ka)$ is a Bessel function. As a approaches zero, the original energy equation becomes

$$P_f^2 \times df = 8\pi KT \frac{\rho}{c} f^2 \times df \qquad (4)$$

and the r.m.s. pressure p in any frequency interval $(f_2 - f_1)$ is determined to be

$$\overline{P} = \left| \frac{8}{3} \pi KT \frac{\rho}{c} (f_2^3 - f_1^3) \right|^{\frac{1}{2}} \qquad (5)$$

Herein was presented for the first time an approach to the calculation of absolute hearing threshold. Using equation (5) Sivian and White determined the pressure P to be equal to approximately 5×10^{-5} microbar for a frequency range 1000–6000 cps. This level, which is 86 db below one microbar, was felt by them to be quite close to the minimum threshold measured in the laboratory, which is an average of 76 db below one microbar in the same frequency range.

In 1948, deVries[3] approached the subject from the physioneural viewpoint. The referenced article dealt with the minimum perceptible stimulus for vision, touched on nerve excitation and then briefly touched upon hearing stimulus. In the article, deVries stated that the minimum perceptible stimulus corresponded to the absorption of a single light quantum by a molecule of visual purple in each of several retinal rods. For simplification, he assumed that only one rod need be excited. This gave an equation for the number of spontaneous thermal excitations:

$$q = \left| \frac{N}{\tau} \right|^{-E/kt} \qquad (6)$$

In this equation, E is the energy necessary to decompose a visual purple molecule. The exponent denotes the probability that the essential part of the molecule has a thermal energy greater than E at a given moment. In every second, there are $1/\tau$ new distributions of energy and N is the number of sensitive molecules in one cell. Equation (6) is rewritten as

$$E = 2.3KT \log \left(\frac{1}{q} \frac{N}{\tau} \right) \qquad (7)$$

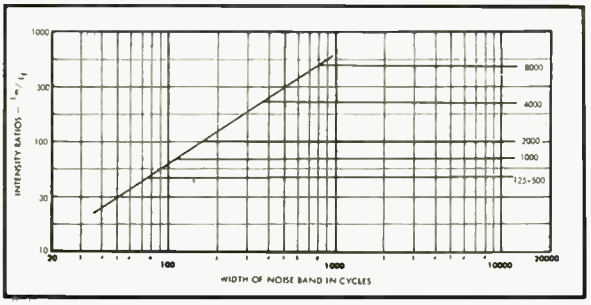


Fig. 1. Ratio of intensity of masked tone, I_m, to intensity per cycle of noise, I_f, plotted against width of noise band in cycles. (After Fletcher, Revs. Modern Phys., Vol. 12: pp. 47-65, 1940.)

* *P. O. Box 137, New London, Conn.*

[1] Sivian and White, "Minimum audible sound fields." *J. Acous. Soc. Am.*, 4, pp. 305–307, 1933.

[2] Lord Rayleigh, *"Theory of Sound,"* Vol. 2, Sect. 302. Dover, 1945.

[3] deVries. "Minimum perceptible energy of Brownian motion in sensory process." *Nature*, Vol. 161, p. 63, Jan. 10, 1948.

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From this formula it is possible to calculate the energy required to excite the molecules or, more aptly, to set a minimum boundary for excitation which will prevent the eye from incurring spontaneous excitations. This value has been calculated from experimental anatomical data giving a figure of $E = 53KT$ for excitation of less than one response per second. Carrying on this line of reasoning, deVries then pointed out that it is possible to calculate the energy necessary to excite a nerve. He derived a figure of $25\ KT$ as being the least figure for which a nerve would be stable.

In deriving a formula for calculating the pressure of the Brownian movement, Sivian and White[1] observed that it was extremely doubtful that the loudness of the various frequencies over the band considered by them would add together in a simple manner. Continuing in this vein, deVries stated[4] that it was more probable that subliminal excitations would add only if they corresponded to the same region of the basilar membrane. Using this reasoning, he selected a band width of 400 cycles at a frequency of 2000 cps and calculated the Brownian movement to be equal to 4.8×10^{-13} erg/sec or an equivalent energy of $0.4 \times 4.8 \times 10^{-13}$ erg, (1.9×10^{-13} erg). Compared with the standard minimum audible energy threshold at the eardrum of 2.4×10^{-10} erg, the figure obtained by deVries is approximately – 31.0 db.

Here it should be noted that the use of a band width of 400 cycles by deVries was based upon the masking studies of Wegel and Lane as reported in the *Physics Review*, Volume 23, p. 266, 1924. Since this report, considerable experimentation has been carried out to determine the critical bands of frequency which are effective in masking pure tones. Fletcher[5] presented the results of his work on this subject in the form of a graph, *Fig.* 1. This graph is a plot of the ratio of the intensities of the tone under observation I_m and the intensity of the noise band I_f versus the width of the noise band in cycles. The parameters are the frequencies of the pure tones employed in the study.

It will be noted that for a particular test frequency, the ratio of I_m/I_f increases with increase in band width until the band width reaches a value beyond which no effective increase in the ratio of I_m/I_f is required. This value is represented on the figure by the intersection of the horizontal line pertaining to the definite frequency with the sloping line originating at 30.30.

Reference to the figure gives a band width of 80 cycles for a frequency of 1500 cps. Substitution of this value into the equation of Sivian and White results in a noise value of 2.48×10^{-6} dynes/cm² or a level of – 39.3 db relative to standard threshold of 2.0×10^{-4} dyne/cm². These calculations are repeated for enough points to give the curve (F) in *Fig.* 2.

Inspired by Fletcher's work in developing the subject of critical bands, Schafer, Gale, Shewmaker and Thompson continued the study[6] at three test frequencies—200, 800, and 3200 cps. Their experiments showed critical band widths of 65, 65, and 240 cycles at the three test frequencies respectively. Employing these band widths for computation of the Brownian movement and extrapolating results in a curve (S) which very closely approximates curve (F).

Threshold of Audibility

At this point, consideration should be given to the value obtained for the intensity of sound at threshold as derived by a number of experimenters. Greatest sensitivity obtained by Sivian and White[1] for free field conditions was 1.9×10^{-10} erg/cm²/sec at a frequency of 3800 cps. At 1500 cps, the sensitivity obtained was 7.6×10^{-10} erg/cm²/sec. Using a figure of 0.43 cm² for the area of the ear drum, the figures obtained may be converted to energies which are equal to 8.2×10^{-11} erg/sec at 3800 cps and 3.3×10^{-10} erg/sec at 1500 cps.

One other factor affecting the sensitivity of the ear drum needs to be considered—namely, that factor representing the percentage of energy transmitted to the inner ear. It is considered that approximately 20 per cent of the acoustic energy presented to the ear drum is reflected at a frequency of 1500 cps.[7] As a consequence, Sivian and White's data would give a threshold energy flow of 2.6×10^{-10} erg/sec.

In a series of experiments, deVries found[3] that duration of the signal determined the minimum audible intensity of sound. For short signals (0.2 second or less) the intensity was inversely proportional to the length of signal, indicating that the energy for audibility was a constant. By comparing with longer duration signals, he obtained a factor of 0.4 which he used to convert data obtained by Sivian and White to minimum audible energy. Use of this factor gives the minimum audible energy at 1500 cps as 7.2×10^{-11} erg for an average good observer.

Through this same procedure, deVries converted data[7] obtained from Geffcken[8] giving a threshold energy of 0.8×10^{-11} erg at a frequency of 1500 cps for a good observer. It must be borne in mind that Geffcken's data were obtained by the minimum audible pressure method which he claimed, in this case, to give results which agree with those of the minimum

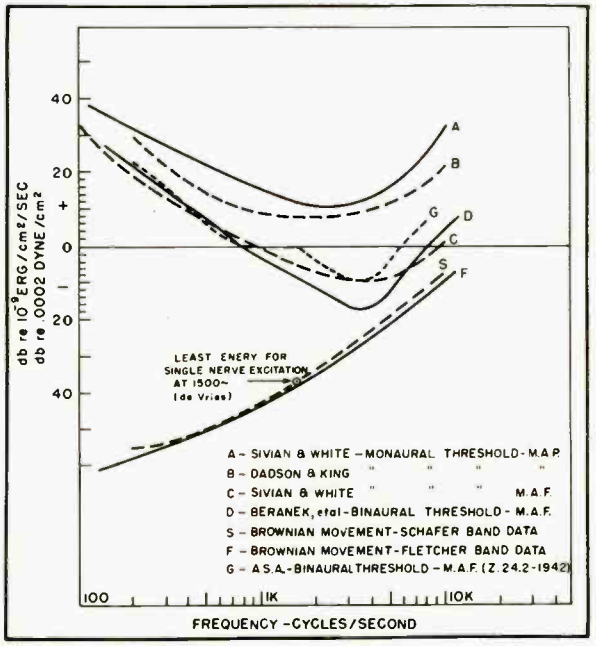


Fig. 2. Relationship between auditory thresholds and calculated Brownian movement of air at 27° C.

[1] deVries, "Brownian movement and hearing," *Physica*, Vol. 14, No. 1, pp. 48–60, 1948.

[5] Fletcher, *Speech and Hearing*, pp. 171–2. Van Nostrand, 1953.

[6] Schafer, et al, "Frequency selectivity of the ear as determined by masking experiments." *J. Acous. Soc. Am.*, Vol. 22, No. 4, pp. 492–3, 1950.

[7] deVries, "The minimum audible energy." *Acta Oto-Laryngology*, Vol. 36, pp. 230–235. 1948.

[8] Geffcken, "Untersuchungen über akustische Schwellerwerte." *Ann d. Physik* 19, pp. 829–848, 1934.

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audible method. This agreement of data is at slight variance with results determined by Munson.[9] Of more importance is the fact that Wever and Lawrence[10] indicate that deVries is in error in these calculations by assuming an area of 0.3 cm^2 for the ear drum and a duration time factor of 0.4. It is their contention that more correct data would be an area of 0.43 cm^2 and a time factor of 0.2. For the purpose of continuity in this article, however, data employed by deVries will be used to complete the discussion.

Previously, a value of *25KT* was presented as the least figure of energy for which a nerve would be stable. This corresponds to an energy of 4.14×10^{-14} erg at a temperature of 27° C. Use is made at this point of the standard threshold intensity of 10^{-9} erg/cm^2/sec which, converted to energy absorbed by the ear drum per second becomes 2.4×10^{-10} erg. By comparison to the standard reference level, the least required energy to excite a nerve is −37.6 db.

The average threshold of hearing obtained by Sivian and White, using the minimum audible field method, at a frequency of 1500 cps, was −3.8 db relative to standard threshold. The threshold obtained by Geffcken was −14.8 db relative to standard threshold. It is readily apparent that a wide gap exists between these thresholds and the threshold of spontaneous excitation of nerves.

Figure 2 presents part of the threshold data discussed previously in this paper and illustrates the proximity of the calculated Brownian movement to the thresholds as determined by various experimenters. In order to evaluate the auditory threshold data more accurately, the figure not only illustrates the results of experiments by Sivian and White[1] but includes as well, data collated by Beranek[11] and experimental data from Dadson and King.[12] Note particularly, that closest approach of auditory threshold to detection of Brownian movement is in the frequency range 3000–5000 cps and in this range, detection of Brownian movement is separated from the extrapolated curve derived from Schafer's data by merely 6 db when compared with Curve (D). Before assumption is made that we are poised (audibly) on the verge of a vast new sound field, it is well to recognize that Curve (D) is not the direct result of measured data nor is this made clear in the caption beneath the curve as presented in Beranek's book. A personal communication from Dr. Beranek states in part "It is very possible that curve No. 3 in my paper is not a curve that can be actually measured because it was obtained by the following process. I took the threshold of hearing as published by the American Standards Association and subtracted from it the difference between the binaural curve for a sound source in front of the listener and the binaural curve for a number of sources located randomly in a horizontal plane about the listener's head. Therefore Curve No. 3 was a derived curve and not a measured curve."

Under the circumstances, we are restricted to use of the curves (C) and (G), both of which are substantiated by laboratory data from subjective measurements. Deviation of these curves from the calculated Brownian movement is approximately 14.5 db at the closest proximity, indicating inability to detect the Brownian motion of the air.

A consideration of greater importance, as concerns Brownian motion in general, is the Brownian movement of the ear itself. Generally speaking, the movement of the air will cause only a part of the total phenomena ascribed to Brownian motion as detected by ear. It is pointed out by deVries[4] that the ear drum and the inner ear may be compared to two electrical circuits coupled by a transformer. Under conditions of good coupling, there will be correlation between the Brownian currents in the two circuits. If there is a decrease in the coupling, the correlation between currents will be smaller but the energies will remain the same. Through this analogy then, deVries believes that, if Brownian movement could be heard, it would be that of the ear itself, not the movement of the air at the drum. He estimates the former movement to be 100 times larger in the frequency range 1000–1500 cps. From this, we may expect that the ultimate audible threshold will be determined by the ear's Brownian motion and not that of the air at the ear drum.

Detectability of Brownian Motion

Data have been presented previously concerning the estimated requirement for least energy to excite single nerves. This value (*25KT*) has been indicated in *Fig.* 2. A question arises immediately concerning the lack of detection of the Brownian movement signals by the ear. This has been examined by deVries[13] and the discussion which follows is based upon his reasoning.

Minimum audible energy for frequencies between 1000 and 1500 cps is 8×10^{-12} erg or *200KT*.[1] From the work of von Békésy and Wegel and Lane, it has been established that 60 per cent of the energy resulting from the presentation of a pure tone at a frequency of 1000 cps causes excitation of a small length (5.0 mm) of the basilar membrane. Accordingly, presenting energy to the ear will cause excitation of approximately 5.0 mm of the basilar membrane at a frequency of 1500 cps. Such a length of the membrane will include about 3000 sense cells. Equal distribution of the original energy at threshold (*200KT*) would mean an excitation energy for each cell of *.0018KT*. More important, the damping time of the ear is about .003 second, which means that at any time an energy of only $.0018 \times .003$ or $5.4 \times 10^{-6}KT$ erg is available to the sense cell. Such a low value of energy would preclude firing of the cells unless some accumulative process was available to the ear.

Let us assume then, that the ear is capable of integrating sound over a period of 0.2 second. The original energy of *200KT* is present for 0.2 second and distribution among 3000 cells gives an effective excitation of *0.067KT*. This is the threshold capability of the ear. Then study the effect of Brownian noise added to this excitation. Masking experiments set a band width per cell of approximately 75 cycles at a frequency of 1500 cps. The Brownian noise will correspond to *75KT*/second and in 0.2 second would be equal to *38KT* (it cannot be more or the sense cells would be active permanently). The fluctuations will be approximately $\sqrt{38KT}$ or *6.2KT*. This signal-to-noise ratio of *.067/6.2* would effectively prevent detection of the signal and once again an impasse is reached as regards the theory of the functioning of the ear.

These discrepancies of the hearing theories have pointed to consideration of theories not affected by the "all or nothing" nerve firing limitations and have led to the belief that the action of the basilar membrane fibers is of a nature other than that previously considered. Consideration is given by deVries[13] to a new theory which relates tension of the nerve fibers of the membrane, as affected by motion, to an electrical voltage whose polarity and magnitude are governed directly by the tension forces. Through his theory he explains that the action of the Brownian motion of a cell would be dissipated over a comparatively large area by virtue of a multipled parallel connection of cells, whereas a displacement of the tectorial membrane would cause all cells to act together, giving an in-phase voltage.

This theory, supported in part by some experiments of von Békésy, may aid in developing a better comprehension of the

(*Continued on page 68*)

[9] Munson and Wiener, "In search of the missing 6 db," *J. Acous. Soc. Am.* 24, No. 5, pp. 498–501, 1952.

[10] Wever and Lawrence, *Physiological Acoustics*, p. 64. Princeton University Press, 1954.

[11] Beranek, *Acoustics*, p. 395. McGraw-Hill, 1953.

[12] Dadson and King, "Determination of normal threshold of hearing. *J. Laryng. and Otol.*, Vol. 46, No. 8, pp. 366–78, 1952.

[13] deVries, "Brownian motion of transmission of energy in the cochlea." *J. Acous. Soc. Am.*, Vol. 23, No. 6, pp. 527–33, 1952.

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The Artistic Integrity of the Record

OTTO MAYER-SERRA

Why shouldn't the ultimate aim of musical performers—solo or group, vocal or instrumental—be to achieve their own kind of fame through recorded performances rather than through concert hall appearances? Can't records be an end in themselves?

THE STEADILY GROWING ACHIEVEMENTS in the field of recording and reproduction techniques have created a new reality of musical performance which has not yet been grasped or fully understood in its artistic and sociological significance. The high-fidelity record should not be judged by the current criteria derived from the performance of music in the concert hall, but we should break away from preconceived ideas of concert performance standards when we move in the field of audio. It is time to take a new critical attitude which will allow us to analyze the record from within its own sphere.

The comparison of the 78 record with the performance in the concert hall was unavoidable, as the old technique offered us a mere suggestion of how music really could and should sound. The LP record, in many respects superior to the living performance, makes such a comparison preposterous. After having listened to thousands of records in the last years, it no longer occurs to us to compare the recorded sound of an orchestra with its "real" sound in the concert hall. The current advertisements of audio equipment "which bring you the realism of the concert performance in your own home," strike us as being beside the point. When recently a famous conductor declared to us in an interview that the record is for him "a kind of photography, which needs, as does all photographic art, excellent illumination," we realized more than ever the need for a clarification of concepts. How many people today owe their musical education exclusively to recorded music—people who have never attended a concert performance or an opera!

The idea that the record is a mere black and white photograph of a splendid and colorful reality comes from the long existence of the 78 record, and because of the serious shortcomings of recording techniques, "canned music" was thought to be inferior to the fresh product. There is no reason to approach the LP record of today in that frame of mind.

The comparison between recorded music and the photographic reproduction of a painting is not adequate, because, a piece of music, if it is not brought to sonorous reality from its score, has no reality at all. Music only "lives" when it is played or sung, and its performance today has the same reality if its impact upon the public is made via the concert hall or via the microphone which transcribes the music onto a record. In both cases, music has to be rescued from the dead notes of its score through the action of a similar physical process whose basic laws are the same although the media of realization are different. Neither of these two ways of making music live is perfect, but both give us specific compensations for their respective shortcomings.

Live Concert Limitations

The handicaps of the living performance are many and are very well known: there may be mistakes in interpretation, pianos may get out of tune during a recital, performers may be at less than their best because of mood or health, the hall may suffer from acoustical imperfections or from "dead" spots, the public may be noisy or afflicted with colds and coughs. . . . To these things add the inconvenience of being obliged on a certain day at a certain hour to leave your comfortable home and perhaps slog through the rain to a cold (or stuffy) concert hall. Perhaps you had a very busy and tiring day and might really prefer to rest on a couch at home and read a detective story. Furthermore, you may have to listen to a symphony which bores you or one performed by an incompetent (in your opinion) conductor to be able to hear your favorite violinist or some modern work which may come at the end of the program.

But, on the other hand, the compensations are many. You get a sound quality of a different order from that received from recorded music, and you also get the full impact of the personal appearance of the artist. There is the always fascinating "show" of a big orchestra in full action, and the general assistance of visual perception which helps us understand how the artist achieves his technical virtuosity . . . dazzling octaves, the fairy-like notes of a bouncing bow, or the force and grace of a conductor's baton. The personal glamor, showmanship, and stage presence of many artists add an important element to their performance. In opera, of course, this is a substantial part of the whole, when added to the components of scenery, costumes, and lighting. And let's not forget the social compensation of concert and opera-going—the eagerness of the ladies to show off a beautiful gown and jewels (a very important element in maintaining the interest of our concert life and opera season), the pleasure of meeting friends during intermission and talking over with them the latest gossip and the splendor of the tenor's high C, and the atmosphere of an auditorium full of people dedicated to an evening of artistic excitement. Furthermore, there is a feeling of belonging to a privileged group, whether you sit with the furred and jeweled ladies in a box, or with the intellectually arrogant students in the gallery.

All this is denied to the record listener. But he can claim an impressive number of compensations of his own. He can choose the right time to hear the right music and he can listen to it in the intimate surroundings of his home. Instead of being submitted to the effects of mass psychology, he can listen to the music and to it alone (perhaps with a score in his hands), he can enjoy it in all its artistic purity without being in any way distracted by extra-musical elements. The most famous artists and orchestras play for him alone, giving him a feeling of special privilege, for he can be utterly close to the music and its greatest performers. The piano is always in tune, even if he listens to Gieseking or Backhaus for hours. No wrong notes, no mistakes, no false entrances; this is music in its supreme perfection.

The Real Differences

The most important difference between the live performance and the record is obviously the quality of the sound. The lecture-concerts of Gilbert A. Briggs revealed that

OTTO MAYER-SERRA

Born Barcelona, 1904, from German-Spanish family. Studied musicology at Berlin, Colonia, and Greifswald, receiving his Ph.D. in 1929. Became, successively, assistant to Dr. Hermann Scherchen at the State Radio, Berlin, music critic and teacher in Barcelona, researcher on Mexican and Latin American music in Mexico, author of several books, including the first Dictionary of Latin American Music. He became a music critic, and was, for several years, publicity manager of Carlos Chávez, manager of the Xalapa Symphony Orchestra. In 1952, he founded the first record magazine in Spanish, **33 1/3**, which carries a regular 24-page supplement dedicated to high fidelity.

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recording and reproduction techniques have reached such a high standard that—in spite of their qualitative differences—the similarity between live sound and recorded sound is so close that many experienced listeners could not, by the testimony of their ears alone, distinguish between recorded music and living music. This means that we have come to the point where recorded music has reached the development of its own integrity as a full-fledged means of making music come alive in its own right. It is no longer a substitute; it is an entity.

Each score written by a composer requires its realization by a performer. The composer always needs an intermediary between the products of his imagination and the public in order to make himself heard; this is also the case of the group of composers of the *musique concrète* who write directly for electronic instruments.

In earlier ages of our musical history, the composer himself was always the performer of his music. With the general "division of labor" of the 19th century, the composers and performers split into two different groups of "specialists." The composer dedicated himself to creating his scores and relied on trained instrumental performers or singers to present them. He used an intermediary who became the means of transmitting to us the music he wrote. But the record uses two intermediaries—the performer, and the electronic process of reproduction.

It has been said that the change in the technical means of presentation of music has been to the detriment of the composer, who wrote his works for live performances in the concert hall. But during the last century new technical resources and different media were customarily used in performances of music written for quite different groupings of instruments and sizes of halls. As early as 1784, a century after his death, Handel's "Messiah" was performed at Westminster Abbey with an orchestra of 250 players and an enormous choir, whereas for his first performance of the work, Handel had only forty instrumentalists and twenty voices at his disposition. Bach is played on concert grands and electric organs today, and the modern devices of lighting and scenery at the present Bayreuth Festivals are very much beyond Wagner's conception. Mozart's operas are performed in halls ten times as big as the theatres he wrote them for. This means that the original cast, performer, instrument or hall for which the composer wrote has vanished into oblivion. The record is only yet another link in the chain of new material means of performance, and does not alone establish a radically new principle of the reproduction of a score.

The only measure of faithful performance is that of adherence to the truth of the score. On this basis, the record generally gives us greater faithfulness than the living performance.

During a concert, the performer, as we have seen, is not in complete control of all the elements involved in order to guarantee perfection. The final product of a record is always the result of a tremendous amount of study, worry, and dedication to achieve perfection. A careful research of all the acoustical problems involved is being carried out (hall or studio characteristics, reverberation, diffusion or reflection of sound, resonance, phase differences, dynamic values, and so on). Infinite experiments are being made in placing the musicians and microphones. Every attempt is made to eleminate the slightest mistake in interpretation. For the first time in the history of musical performances, nothing is left to chance: each record is meant to be a definite and perfect realization of the score, not only in its artistic meaning, but, also, in all its acoustical implications.

"High Fidelity" Implies Perfection

This should be the real meaning of "high fidelity." This now so-much-abused label should be much more than a description of design qualifications or recording techniques. Actually it implies a new meaning —that of sound production in the spirit of utter faithfulness to the score in all its aspects to an extent no composer had ever dreamed to be possible. During the last decades, the much discussed "fidelity" to the scores of composers, championed by men like Mahler and Toscanini, meant only the exact realization of every detail of the score as written down by the composer. Today real "high fidelity" is a great deal more: the performer and the artistic director of a recording are constantly checking over the complete realization of the score and the exactitude of its musical and dynamic values, but also, working with the sound engineer, the perfect acoustical balance with all its implications from the point of view of the listener—something which the conductor in the concert hall, standing as close as he does to his orchestra, can seldom achieve. Musicians like Hermann Scherchen claim the necessity of recording each composer's works within a specific sound atmosphere, according to the style of each work. Some of the most alert artists even go so far as to try to develop a specific recording style, which might be of the greatest importance for the future of the LP record, and might reflect upon concert-hall performances in the same way in which the development of the cinema and television have affected the stage.

Therefore an acoustical clarity and balance is reached on the record which permits us to hear details frequently lost in the concert hall. Although the power output of home music is infinitely smaller and the whole impact is received from only one single source (or from two in stereophonic reproduction), our ears quickly get used to the different sound level and quality, and we have no difficulty in identifying the truth of a reproduction as much as the definition of details—solo passages, both instrumental and vocal, polyphonic texture, rhythmic and accompanying figures, balance of dynamic values, and so on.

Although pleasure in the sound qualities themselves afforded by a good equipment has won many friends to the enjoyment of music, "high fidelity" in its broadest sense means a revaluation of the artistic content of a composition. Hi-fi in the current sense has no artistic value by itself. It gives only limited pleasure in its sonorous virtuosity, much as a pianist gives pleasure through the agility of his fingers. But, as in all virtuosity, it accomplishes its whole reason for being only if it is put to the services of art. Many outstanding "hi-fi" recordings, with mediocre performances, show us the danger of this new road opened up to us by electronic achievement.

Fame Through Records

The new world of the record (or the tape) has reached its autonomy, although many of its problems are still submitted to renewed exploration and solution. Many artists became famous recording artists who had never achieved fame through personal appearances. There are wonderful conductors and singers on records—*phonogenic* artists, as Igor Markévitch calls them —who are failures in the concert hall, and others—Maria Callas, to name only one famous example—who seldom give us the emotion on a record which they are able to project from a stage.

In a recent interesting article in the Saturday Review, in which Irving Kolodin spoke of the disappointment to the public of certain famous recording artists when they were heard in person, he stated:

"It may be that the end of the film actor's purpose is to make films, whereas the end of the record performer's purpose is to make his name known in the concert hall or opera theatre. Thus, the film is an entity in itself, whereas the record is but an intermediate step to the point of true celebrity."

Why an intermediate step? If we admit that true celebrity can be reached in films by an actor who has never appeared on Broadway, why not admit that true celebrity can be reached by an artist who has never been applauded in Carnegie Hall? We firmly believe that the world of the record is strong enough (and will continually grow stronger) so that certain artists who achieve fame in this medium will consider it an end in itself, especially since being successful in the record world brings with it an economic reward in many cases superior to the fees earned in public appearances. These two worlds of sound production are already so widely split apart that in tests made by the Dutch Philips between the same pieces played by records and by living musicians, only 17 per cent out of 300 listeners (including professional musicians) were able to give the right answer.

This means that in spite of the enormous difference between the two means of sound reproduction, the record and its reproduction have already conquered most of the qualities of the living performance, to a point at which the specific characteristics of the recorded sound (including its shortcomings) appear to the listener, educated in the concert hall, less striking than the similarities between both of them.

Probably we are only half way along the road in the exploration of electronic sound reproduction. This is one reason more why we should give up the comparison of artists and recordings with living performances. Artists on records should be judged exclusively on their own merits as recording artists, and records should be evaluated on the highest level of present recording techniques.

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at home with AUDIO

LEWIS C. STONE

There Is No Hi-Finality

I. Resurvey of living room results in revised requirements for speakers and new self-built enclosure in de-luxe hi-fi system.

THEY TELL US that letter writing, like the art of conversation, is on the wane if not yet a lost art. It is no paradox, either, to remark that we'd rather talk than write; and that we prefer spectation to conversation has become a bleak fact, Fadiman's radio spot so-named notwithstanding. Reflecting this condition we have been careful, in this department, to use "communication" when suggesting or acknowledging articulate reader participation. And now, literally speaking, it has happened: this time about an equipment change, a topic on the agenda of this department. One of our readers has put tongue to mike and sent us a reel of tape-talk recording a communication, or audio-note, about speakers—the cone and voice-coil kind, that is.

Fig. 1. Objective: at-home-with-audio conditioned speaker system. Behind plastic grille, a three-way system combining two Bozak woofers and a Bozak mid-range with Altec-Lansing tweeter, in self-built infinite baffle.



In the transcript that follows further along, reader Schwartz explains in his own pointedly laconic words why (this happened less than a year after his then finalized hi-fi system was described in these pages, March, 1955) he decided to change from a two- to a three-way speaker system, from bass reflex to infinite baffle housing—which he built himself, and that too he describes, from lumber cut to furniture finish.

We find it difficult to resist inferring (as would you, in our place) from the following dissertation on the savories of hi-fi, that between one year's hi-fi show and the next, life for the confirmed practising hi-fi enthusiast is a rather aromatic mixture of blessings enjoyed now with a tantalizing, but bearable, suspense as to blessings yet to come in the hi-fi thereafters. There's always a *FI* $^{hi\text{-}hi}$ in his future.

And they tell us that it just ain't the same system, come the aftermath of getting booster shots of hi-fidolatry at those revival meetings called audio shows. And how else? The customers are prodded and primed and educated the year around by the hi-fi press (such as, respectfully yrs, AUDIO, et al). Then, naturally they are completely fascinated, stimulated and won over by the massed "sight of sound" at one audio rodeo or another. Indefatigably at bray day after day, the fixtures at these exhibitions manage successfully (as they were intended, via the hi-fi audio dealer) to tune, amplify, spin, track, reel, treble, bass-reflex, folded-horn, infinite-baffle, and catenoid their ways into ranch and split-level, apartment and attic, basement and boudoir, or wherever—singly and in droves (on which all depended). And of course the "way" was paved with sound hi-fi dollars, to a guestimated top of near one hundred million, this past year.

The Forever Buyer

Having managed over some years to get the affordable best in audio equipment, our hi-fier-of-the-month was recently urged by "popular" demand (that is, some friends, as we shall see later) to do something about the speakers as they sounded "in the room of their location." Not that the speakers in use were less than the best of their kind, but that they seemed to these experts, to get less than their just due in that room's acoustic properties, structural characteristics, and space limitations. Like him (and you, and you) these audio friends had learned, when considering speaker-behavior "at home" to get themselves into a decidedly subjective state of (to coin a phrase) "just listening around for the right feeling."

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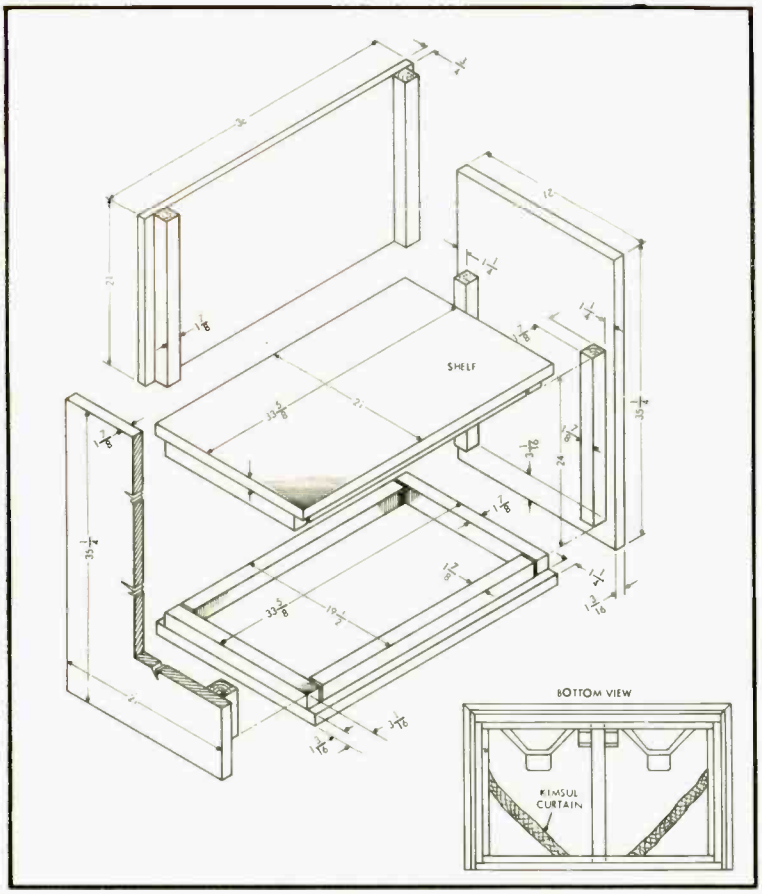


Fig. 3. Isometric view highlights simple building method. Heavy strips are secured to flats as in pallet or skid type construction. They reinforce corners when panels are fitted together. Inset shows placement of Kimsul curtains to eliminate internal standing waves.

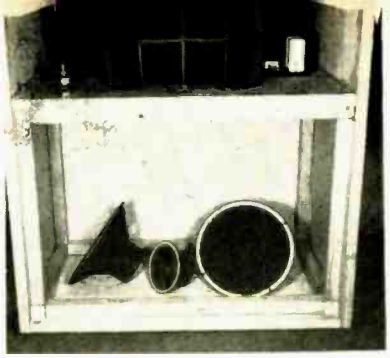
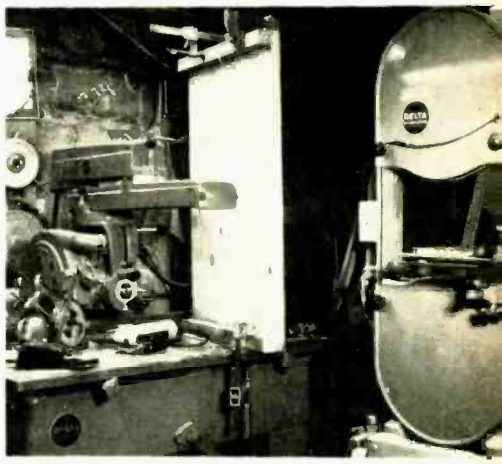


Fig. 2. Mock-up of installation in cabinet of extra-heavy veneer lumber. Lower compartment is full size Bozak enclosure; upper has been added to hold hold-over tweeter. T-pad on shelf, at left.

Fig. 4. Corner of well-stocked workshop shows heavy veneer panel under clamps. Other tools shown: Delta radical saw, band saw; Stanley portable router; Lestro Scintilla saber saw; Jorgensen wood clamps; Pony bar clamp fixtures.



Listening to these people, "flat" as well as with the inner ear of acquisitiveness, our reporting reader was a somewhat vulnerable hi-fier with throbbing, exposed audio-tory nerve sensitive to all and sundry in the speaker line, that trekked from booth to booth at a recent *carnaval du son* (N. Y.) His was an errand of decision, not merely a foray by a window-shopper who, even as he scans the merchandise, intones a "good-bye" to many a good buy before (finally) he lets out the "hello" of acceptance leading to purchase.

We daresay that as a hi-fier yourself we doubt you'll play surprise when we report that, like you, your hobby brethren also dabble in other forms of gadgetry. Anyway, the hi-fiers we have visited turned out to be combination "pic (for picture) and pickup" fans. For them, the tangible realism of stereophonic sound is opposite-numbered with a Stereo-Realist camera or the like. For one of them, visited recently, a Hasselblad camera with accessories (costly?!) is in the offing (ex a Contax). Naturally, it is often a toss-up which of these hobbies will be shown off first to the visitor: color slide or movie reel; or sound unreeled from disc, or spooled from live-recorded tape reel. But for all of his hi-flying, our combo-hobbyist is a responsible person—that is, responsible for hundreds of millions of dollars in purchases for living in the round—and per annum, too.

The Buying Complex

And we are told that a good deal of switching of make or model, or choice of an entirely new hi-fi additive (for



Fig. 5. Bozak assembly in place, with Altec-Lansing tweeter on shelf over. Non-resonant baffle is monolithic Chemstone fitted to framing over gasket, secured with bolts.

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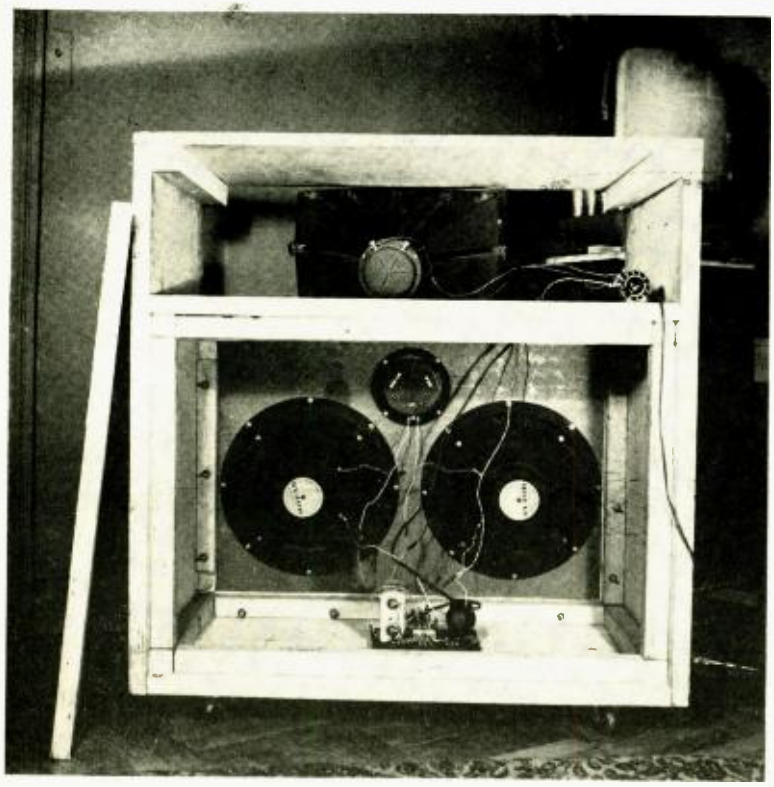


Fig. 6. Sub-vital statistic: Orderliness of cabled wire-up is recommended, but curl-paper wire-do is practised. T-pad for treble attenuation on top shelf, crossover on bottom. Note bolts holding baffle for woofer-mid-range speaker array.

Fig. 7. Saran grille cloth covers front and two sides of infinite baffle enclosure. Owner shown putting body-English into job of stretching fabric tight and plumb as he fastens lap-over to rear panel with automatic stapler.



instance) it due not only to what the engineer has put in for the ear to "see" but also what the designer (who may be the same person) has with corresponding skill put *on* cosmetically for the eye to want. More subtly, but powerfully effective and decisive, the buy-ways of the deep-dyed hi-fi buff are sometimes a little on the devious side, traversed within the envy-clad walls of an enclave of small frustrations seeking compensation. Also that the final buying decisions may perch a-straddle on the bastions of brag and boast: those solid, two-fisted, snob-nested allies of the seasonal or annual sell-and-purchase routines. (On which we all depend).

Then, too, a sense of competition with one's best hi-fi friends is vitally a factor in the big surge behind many an urge to splurge. Maybe lots of brand new models of hi-fi components are bought long before their earlier counterparts are ready for the discard. More circumspect, essentially, are the decisions made with regard to speakers, as the wisdom of having chosen speaker *A* over *B* comes to light perhaps only after you've bought and lived with either or both, were that possible. You buy your speaker after having it demonstrated (in and out of comparator labyrinths) and maybe a glance at its specifications and engineering data. But the fine performance levels that claim the eye, via tabulation and published response curves, are not always and infallibly as fine seeming to the more subjective (to the point of being capricious) ear. In these things nature holds all the patents. So far all we've managed are piddling infringements. As to speakers, do not think it presumptuous to leave it to the comparator labyrinths of your own ears to judge how well these patents have been infringed.

First and last, speakers are the "blind mouths" of the hi-fi universe today. Their sound is not alone, for your room is the far from silent partner in these cone-and-horn deals. The speaker's test is, finally, there. And whether that test is passed depends on what your ears perceive pleasingly of the emitted sounds. Directly yes, and subject of course to your judicious exercise of the speaker's and the amplifier's environmental controls. We all know that plaster of ceiling and wall, wood of door and floor, void of opening, furniture upholstered and unholstered, hangings, rugs, shelvings, and so on, all of these absorptive and reflecting surfaces in your (average) living room—the peaks, the null points they cause and create—all of these, not to mention exactly where in the room you have decided to place it, affect and modify the sound-producing formulae engineered and built into a particular speaker or system of speakers. Of these angles of speaker selection, this month's subject is a case in point.

His Coneship, the Loudspeaker

Up to a point and down to a point (a built-in, bracketted range) a speaker may produce sounds without lisp or guttural: harmonic or intermodulation distortion, that is. And there's no heterodoxy in this fact that the ear's version does not always coincide with the (for instance) curves of frequency *vs.* sound pressure seen in many an analytical circular issue about speakers. Actually these curves show nothing more than that speaker's response to a given frequency with *x*-number of db of sound output. Below a certain frequency the speaker is so lightly loaded that it gives out with very little fundamental, or so we are told. And how is this sound output routinely measured? Of course the *where* of it is a part of the process. A speaker on test is put through its paces with a signal generator to which is coupled a recording oscillograph, which traces the response curves mechanically. When the signal generator is producing (say) 30 cps, the bobbling recording nib will be resting on the 30-cps line of the graph paper. As this moving finger writes it will trace a most visible curve on the graph as 30-cps response, and so on along the spectrum, nice *looking* curves, with contours a la Mlle. Monroe, pretty as all get out.

But the speaker (alas) may have no 30-cps response; instead frequency doubles to 60 cps. Yet this off-beat distortion will leave its signature on the graph paper as 30 cps despite the 60-cps sound actually produced. Inconclusive, and counterfeit to say the least, especially as to the bass end. A more proper informative pay-off would be, as some audio engineers suggest, to have the above curve

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Fig. 8. Glue-screw procedure for firmness is feature of this speaker housing job. Owner uses brace-operated screwdriver for easier handling. Note bench is at comfortable working height just below bent elbow.



Fig. 9. Chuck of hand-power drill holds screw-mate to drill pilot hole for screw threads, shank clearance and countersink for screw-heads, all in one operation.

accompanied with a curve opposing distortion *vs.* frequency, or a constant distortion contour curve, as well as indicating the damping factor of the amplifier driving the speaker. Then, they say, would your speaker-questing hi-fi buyer be happier in making a proper selection.

Quite so, to all this, which about translates a procedure for testing loudspeakers, suggested by ASA and RETMA as points to be covered in any published data of such tests: 1) Recording of amplifier damping factor. 2) Reference of acoustic output to a specified absolute level. For a speaker may have extended low-frequency response at very low output, but poor low-frequency at any appreciable power, due to the inability of the cone to move far enough. (For, in these circumstances, as stated in this department October 1955, ". . . an amplifier vents torrents of decibelicose tantrums upon a mismate like an under-excursioned cone . . ."). 3) Frequency response data should also include measurement of the fundamental output: something like an associated distortion-frequency curve, discounting distortion components. 4) Distortion measurements should be related to acoustic output as well as to electrical input, since the latter does not take into account speaker efficiency. Ten watts into speaker *A* may produce less sound than one watt into speaker *B*; so the damping factor has to be noted, or else measuring the instantaneous value and phase of the speaker impedance at different frequencies. (The foregoing paragraph is adapted from "Handbook of Sound Reproduction," by E. M. Villchur, Chapter 18, AUDIO, April 1954).

Moreover, the points that have to be considered by the hi-fi buyer are enumerated in as many as nineteen "Facts Affecting the Choice of a Speaker," by J. H. Newitt in his book, *High Fidelity Techniques*.

Time now for your reporter of the hi-fi scene to leave these areas of speculation as to the nature of the hi-fi market and its customers' finest hours. Let us now deal with the buying (and building) decision of our subject reader, and its consequences. We give you reader Joseph Schwartz who has been paying his substantial hi-fi (and camera) bills over the past several years with his (presumably) substantial earnings as manager of the contracts division, Institutional Products Corporation, a New York distributor of laboratory and hospital equipment. He talked the following facts into an Electro-Voice 950 mike, onto a five-inch reel of tape moving at $3\frac{3}{4}$ ips in a Federal model 47-A tape recorder. The reel was mailed to us; we played it back on an identical machine, had it transcribed, typed, and fitted among these dewy paragraphs. (Incidentally, the above portable unit is adjunctive to the portable Ampex 600 tape recorder with the 620 amplifier-speaker unit: all fresh-bought.)

A NEW SPEAKER SYSTEM: WHY AND HOW IT WAS INSTALLED

Tape-Recorded by J. Schwartz

The Build-Up

There are three reasons why I decided to install a new speaker system. I'll list them in the order of their importance to me:

1. Some snide remarks by some of my friends whose opinion I value most highly, to the effect that my highs were all right, but I seemed to be lacking in middles, while the lows left much to be desired.

2. I listened to the G. A. Briggs-Wharfdale demonstration at Carnegie Hall last December. It left me impressed with the fact that recorded music could really be reproduced in a fantastically realistic manner.

3. My attendance at the recent audio show in New York (with the usual set of ear-muffs in my left pocket).

I was then and there faced with the problem of what type of speaker system. After a complete survey of my living room and my present equipment I had, of necessity, to eliminate consideration of a corner system, such as a Klipsch or a Briggs sand-loaded Wharfdale unit. There was then the choice between a conventional bass-reflex type of enclosure and an infinite baffle.

I had happened to spend considerable time in the Bozak booth at the fair and after reading their literature I found that they were the outstanding exponents here of the infinite baffle type of enclosure, and that they had designed their speaker units to work most satisfactorily in that type of enclosure.

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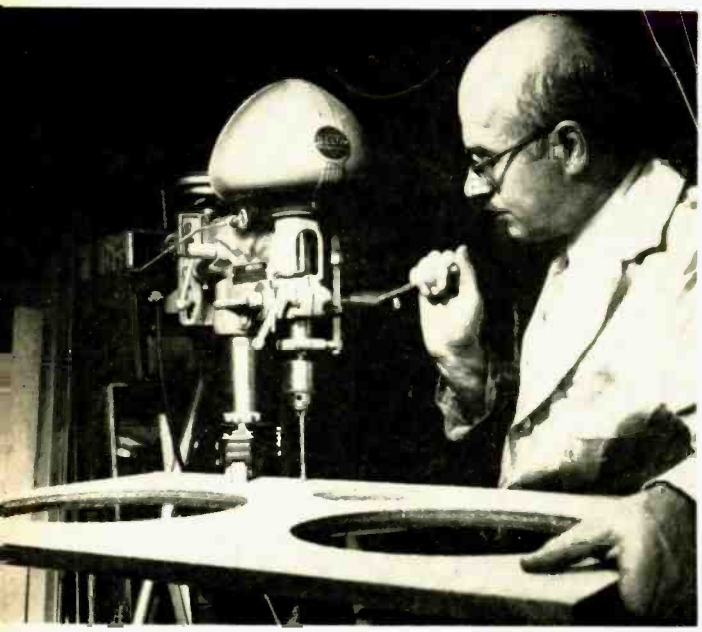


Fig. 10. Delta drill press drives steel drill into Chemstone baffle to locate holes for bolts used to secure it to framing of enclosure.

I was most impressed by their 3-way, B-310 system. But unfortunately, being a cliff dweller and having a living room that measures only some 13 by 14 feet, my first compromise was to decide on the B-305, a 3-way system in a smaller housing, using a mid-range, two 12-inch woofers and two sets of tweeter arrays. I had been using an Altec-Lansing 802B tweeter with the two-by-four H808 horn in my hi-fi system. As that unit represented an investment of over one hundred and fifty dollars, and as I had had no criticism from my expert hi-fi buddies on the quality of my highs, I decided to include it in the new system, using just the two Bozak woofers, their mid-range, and crossover. The completed installation is seen, as located and used, in *Fig.* 1.

Of course I knew I would be faced with the necessity of balancing the efficiency of the Altec tweeter with the other units, but this presented no problems as I inserted a T-pad in the tweeter circuit to cut down on its efficiency (*Fig.* 2). Subsequently some of my more knowing musical friends came up with special recordings. We had quite a session while these experts balanced the whole system and I must say that the resulting listening quality exceeded my expectations.

The Building

My next problem was the actual construction of the enclosure, which I built according to the manufacturer's specifications, but modified, as shown in the isometric drawings, *Fig.* 3. And here I decided to make use of various materials, some of which—to the best of my knowledge—had not been used in the fabrication of speaker enclosures, or are not widely used. All of the books describing construction of speaker enclosures stress the fact that they have to be heavily braced and reinforced, then glued, and fastened with screws.

It is true that you can get ¾-inch plywood at practically every lumber yard. However, in the building trades there is a fir plywood that is 1⅛ inches thick. And this is the material I decided to use for the speaker enclosure (*Fig.* 4). I solved the problem of panel resonance by using a product known as Chemstone, a trade name for an artificial stone made by Johns-Manville of a combination of cement and asbestos (*Fig.* 5). Its most common use is for table and counter tops in chemical laboratories. It comes in various thicknesses but I learned that ¾-inch of this dense, solid, monolithic material would answer the purpose as a baffle.

To further isolate any vibration that might be transmitted to the cabinet housing I decided to use vinyl foam. This is a very new product, used in 1956 autos to form shock and impact-absorbing panels around instrument boards and for sun-visors. It is an extremely interesting material in that it is composed of many tiny cells, like balloons. There is no interconnection between these cells such as you have in sponge foam rubber. I used this homogeneous substance as gasket material, and drew the Chemstone panel up against it with stove bolts, spaced about eight inches apart. (*Fig.* 6). The combination of Chemstone panel and the vinyl foam sponge gasket seems to accomplish the results I was after; namely, no transmission of vibration from the panel to the body of the cabinet. (*Kindly explain sometime about the bolts, which contact both panel and cabinet.* Ed.)

The Processing

The only finished wood surface is the top, which has been made of a piece of mahogany-faced ¾-inch plywood. The grille cloth completely wraps around and conceals all other wood surfaces (front and sides), which are all wild-grain fir plywood. (*Fig.* 7). The entire enclosure is mounted on four 2-inch ball-bearing casters set back a proper distance so that they are not visible from a seated position in most parts of the room. Experience has taught me that all equipment should be mounted on casters for easy cleaning and any possible servicing that may be required. The two moldings at top and bottom of the finished cabinet, are what is technically known in the building trades as chair-rail. They are obtainable from any dealer who handles the products of United States Plywood Corporation. Wire brads are used to attach this molding to the cabinet. Normally this would be glued, but one has to look ahead and if at some time the speaker units have to be taken out, the grille cloth will have to be detached. Therefore the moldings have to be so attached that they can be removed easily, without damage to the fabric.

The Means and Tools

I found these tools very useful and labor-saving: Number one, a brace with a screwdriver bit, as shown in use in *Fig.* 8. Then a screw-mate tip to fit the chuck of a ¼-inch electric hand drill, as in *Fig.* 9. The tip comes in various sizes. This gadget drills a body-size hole for the body of the screw and it countersinks the wood for the screw head, all in one operation.

The strength of a glued joint depends on the clamping pressure used during the setting period. The holes should be drilled first, then both the plywood and the corner cleats covered with glue (I used Elmers Glue-All). The two units should then be screwed together and drawn up very tightly with good quality cabinet makers screw clamps; (these are seen in *Fig.* 4 mentioned earlier). Then draw the screws up to their final tightened position. Leave the clamps on for a long enough time for the glue to set, although this is not quite necessary because the screws will hold the two pieces together quite securely.

Ordinarily a screw will not draw up the pieces tightly enough, although it will hold them together very nicely once the clamps have been applied for the final pressure. The sign of a good glued joint is when the glue oozes out on the edges. Wipe off all excess glue immediately, before it has a chance to harden. Assemble all corner cleats and parts completely, as shown in the isometric drawing, (*Fig.* 3 above) before attempting to assemble the complete cabinet. The large holes in the Chemstone panel were cut by a firm specializing in working this material, or else the local Johns-Manville dealer will arrange to have it done. The mounting holes for the speaker can be drilled with an ordinary steel drill, at slow speed. (*Fig.* 10). Do not apply too much pressure and drill very slowly, in spurts, to avoid excessive heating up and ruining the temper of the drill.

The Finish

Books have been written on how to finish furniture. And there are so many schools of thought that I can contribute nothing except to give those who wish it the method I used to finish the top of the cabinet. It is first sanded lightly. As a bleached mahogany finish was desired, I used a product known as Masking Color, bleached mahogany #4003 as manufactured by the International Paint Company. The excess was wiped off about twenty minutes after application.

(*Continued on page 66*)

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Transformer Design for "Zero" Impedance Amplifiers

N. R. GROSSNER*

A rigorous discussion of a practical method that can reduce weight and volume of an output transformer for zero-impedance output stages without increasing distortion.

TRANSFORMERS have been irksome to the designer of high-efficiency program amplifiers. He knows that higher efficiency yields a smaller power transformer. But the output transformer, as used in class AB and B operation, ordinarily presents him with rather severe problems, especially when high power, low distortion, and wide bandwidth are desired simultaneously.

Progress toward minimizing problems associated with the output transformer seems to take three major directions:

1. Eliminate the output transformer entirely. Apparently this procedure substitutes new problems for old.
2. Use special circuitry to overcome the "limitations" of the output transformer. MacIntosh[1] and Peterson,[2] using high-quality transformers of special design have achieved notable success.
3. Devise circuitry which overcomes transformer "limitations," using small and comparatively inexpensive output transformers. This article is concerned with a development in this category.

The "Zero-Impedance Transformer"

This writer's experience indicates that a compartively small output transformer specifically designed for the "zero" impedance output stage[3, 4] provides performance characteristics at least comparable with the "large" transformer designed for the conventional high-quality feedback amplifier.

The advantages this type of transformer affords when fed by a zero-impedance stage are as follows:

1. Small size. Typical weight reduction is approximately 40 per cent (See TABLE I). It appears feasible to design a high-quality output transformer only 1½ to 2½ times the size of a 60-cycle power transformer of the same power rating. The smallest size is obtained by using a B supply with perfect regulation and fixed bias.
2. Wider bandwidth.
3. Lower inter-primary leakage reactance—reduces "switching" transients.
4. Lower effective primary capacitance. High transformer input capacitance limits the amount of low-distortion high-frequency power from those class AB_1 and B_1 amplifiers that utilize large transformers with bifilar windings.
5. The foregoing advantages contribute to the feasibility of an economical high-performance wide-band Class B_1 amplifier employing a regulated B supply.

TABLE I

TYPICAL WEIGHT REDUCTION DATA

AUDIO POWER	STANDARD			ZERO IMPEDANCE			W_z/W_s	WEIGHT REDUCTION %
	LAMINATION	STACK	W_s (LBS)	LAMINATION	STACK	W_z (LBS)		
15	EI112	1¼	3.28	EI112	⅞	2.12	1.55	35%
35	EI125	1¾	5.69	EI125	1	3.31	1.72	42%
70	EI13	1¾	8.66	EI125	1½	5.4	1.6	38%

The limitations are:

1. This type of transformer appears to be limited to use in the "zero" impedance output stage.
2. The continued need for the type of elaborate winding schedule often used in high-quality large transformers.
3. The continued employment of the same high-quality core material as used in the traditionally large transformer.
4. While the cost is substantially less than that of the large transformer, its cost is higher than the small P.A.-type transformer which it may superficially resemble because of its smaller size.

Distortion

Low distortion has a decisive effect on the size of the output transformer. The equations pertaining to distortion, based on the equivalent low-frequency circuit (*Fig.* 1), follow:

Exciting current

$$I_x = I_C - jI_M \qquad (1)$$

where I_C = in-phase core loss current
and I_M = quadrature magnetizing current
total primary current

$$I_1 = I_x + I_2 \qquad (2)$$

$$= (I_C + I_2) - jI_M \qquad (3)$$

Primary EMF

$$E_p = \frac{I_M}{X_L} \qquad (4)$$

The voltage drop across $(R_G + R_1)$ is

$$I_1(R_G + R_1) = [(I_C + I_2) - jI_M](R_G + R_1) \qquad (5)$$

$$= [(I_C + I_2)(R_G + R_1)] - jI_M(R_G + R_1) \qquad (6)$$

Since I_M is the quadrature magnetizing current containing the distortion harmonics, it is clear that the distortion producing voltage drop $I_M(R_G + R_1)$ subtracted from the input voltage E_G produces a component of the voltage E_p, having a distortion term across the primary reactance X_L. If we assume I_M is *all* harmonics, then the maximum fractional distortion D_T appearing across the effective primary reactance is

$$D_T = \frac{I_M(R_G + R_1)}{E_G - I_1(R_G + R_1)} \qquad (7)$$

$$= \frac{I_M(R_G + R_1)}{E_p} = \frac{E_p}{X_L}\,\frac{(R_G + R_1)}{E_p}, \qquad (8)$$

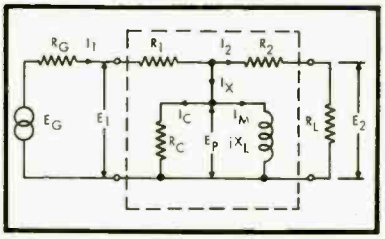


Fig. 1. Low-frequency equivalent circuit.

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* *David Bogen Corp., Transformer Division, 29 Ninth Ave., N. Y. 14, N. Y.*

[1] MacIntosh & Gow, "Description and analysis of a new 50-watt amplifier circuit." AUDIO ENGINEERING, Dec. 1949.

[2] A. P. Peterson, "A new push-pull amplifier circuit." *General Radio Experimenter*, Oct. 1951.

[3] J. Miller, "Combining positive and negative feedback," *Electronics*, March, 1950.

[4] C. A. Wilkins, Pat. Pending: "*Controlled Positive Feedback.*"

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or[5] $$D_T = (R_G + R_1)/X_L, \qquad (9)$$

and the distortion factor due to the transformer alone is

$$D_s = R_1/X_L \qquad (10)$$

The EMF, E_p, across the primary shunt reactance (with the distortion component), in turn causes the load current I_2 to flow through the secondary d.c. resistance and load resistance.

Since we expect to handle the distortion parameters in some detail, it is now desirable to establish the *exact* transfer ratio between input and output. If we solve each loop of the network (*Fig.* 1) using Kirchoff's Law we can write the exact equation:

$$\frac{E_1}{E_p} = 1 + \frac{R_1}{R_C} + \frac{R_1}{R} - j\frac{R_1}{X_L} \qquad (11)$$

where $R = R_2 + R_L$, and

$$\frac{E_p}{E_2} = 1 + \frac{R_2}{R_L} \qquad (12)$$

Multiplying these two equations and separating the real and quadrature terms,

$$\frac{E_1}{E_2} = \left(1 + \frac{R_2}{R_L}\right)\left(1 + \frac{R_1}{R_C} + \frac{R_1}{R} - j\frac{R_1}{X_L}\right) \qquad (13)$$

$$E_1/E_2 = (1 + R_2/R_L)(1 + R_1/R_C + R_1/R)\left(1 - j\frac{R_1}{X_L}\frac{1}{1 + \frac{R_1}{R_C} + \frac{R_1}{R}}\right) \qquad (14)$$

so that the transformer distortion factor (again assuming that the magnetizing current I_M is all harmonics) is the j term in Eq. (*11*),

$$D_s = \frac{R_1}{X_L}\left(\frac{1}{j + R_1/R_C + R_1/R}\right) \qquad (15)$$

or $$D_s \cong R_1/X_L \qquad (16)$$

What is especially significant is that if $R_G \ll R_1$ or better still if $R_G = 0$, then the *total* circuit distortion is determined by the transformer *alone*.

Size of the Conventional Transformer

Before attempting to reduce the size of the conventional output transformer let us see why it is larger than a power transformer of the same rating and at the same time derive an expression for its size in terms of copper losses and distortion.

Assuming $R_1 = R_2$, which is the usual case in a transformer designed along traditional lines, its loss factor $1/Q_s$ will be

$$1/Q_s = R_1/X_L + R_1/X_L = 2R_1/X_L. \qquad (18)$$

X_L is established after a number of considerations:

(a) The lowest frequency the amplifier is to pass in accordance with relative low-frequency response in

$$db = 20 \log \frac{1}{1 - jR_p/X_L}, \qquad (19)$$

where

$$1/R_p = [1/(R_G + R_1)] + 1/R; \qquad (20)$$

(b) The maximum permissible distortion. This is a function, at high power levels, of the flux density B_M in the primary winding. Although the maximum distortion factor is

$$D_T = (R_G + R_1)/X_L, \qquad (9)$$

the inductance, being a non-linear function depends on what the effective core permeability μ_e (see *Fig.* 2), is for a given B_M, which is, in turn, a function of the maximum voltage across the primary, in accordance with

$$E_p = 1.41\,NAB_M f\,10^{-8} \qquad (22)$$

where N = primary turns,
A = effective core area,
and f = lowest frequency of operation.

Then to be certain that at low-frequency high power levels we do not exceed D_T, we must select a reasonable value for B_M to prevent X_L from falling below the minimum established by Eq. (*9*).

(c) In addition to the foregoing, the load line at high power also must be considered. At power levels near maximum, the effective load on the output tubes becomes reactive, the load line becomes "elliptical," and R_G increases due to phase shift in the feedback loop. The impedance Z of X_L in parallel with R_L reduces the effective plate load impedance to a value lower than the optimum (established at mid-frequency) required for maximum power transfer. The lower impedance increases[6] the voltage drop across R_G (power wasted), thereby decreasing the available low-distortion power at the lowest operating frequency.

It is the last two considerations which then traditionally have the most bearing on the size of X_L. Therefore X_L is established by Eq. (*9*) and the following relationship

$$X_L = d_s R_L, \qquad (23)$$

where d_s is usually an integer in the range of 3 to 6 (empirically determined) in order to keep the "ellipse as narrow as practicable" in the high-quality conventional output transformer.

The weight W_s of the transformer (which we will also refer to as the "standard") after combining Eqs. (*18*) and (*23*) may be expressed[7] by

$$W_s \propto Q_s^{3/2} \propto (d_s R_L/2R_1)^{3/2} \qquad (24)$$

Size Reduction Methods

Equation (*24*) suggests several ways of reducing the transformer size.

(a) Increase the copper losses by K; that is, to $2R_1K/R_L$. This however would produce more distortion than the conventional transformer in a zero-impedance circuit.

(b) Reduce the primary reactance by K; that is, make new reactance X_L/K. This would also produce more distortion from the small transformer than the large one used in a zero-impedance stage.

(c) Make the distortion of the small transformer the *same* as the large one in the zero-impedance stage. A special procedure for accomplishing this will be described.

A Special Design Procedure

Equation (*15*) tells us we would obtain zero distortion if R_1 could be reduced to zero. Although this is not phys-

[5] The writer is indebted to D. Wildfeuer of Arma Corporation for this simple formulation of maximum distortion.

[6] R. Lee, "*Electronic Transformers and Circuits.*" Wiley: 2d ed. 1955 pp. 158, 167.

[7] M.I.T. Staff, "*Magnetic Circuits and Transformers.*" Wiley: 1943, p. 228, wherein it is demonstrated that $Q \propto K_a^2$, where K_a is a factor by which the *linear* dimension of the transformer is changed. Q is therefore proportional to volume$^{2/3}$ (and weight$^{2/3}$).

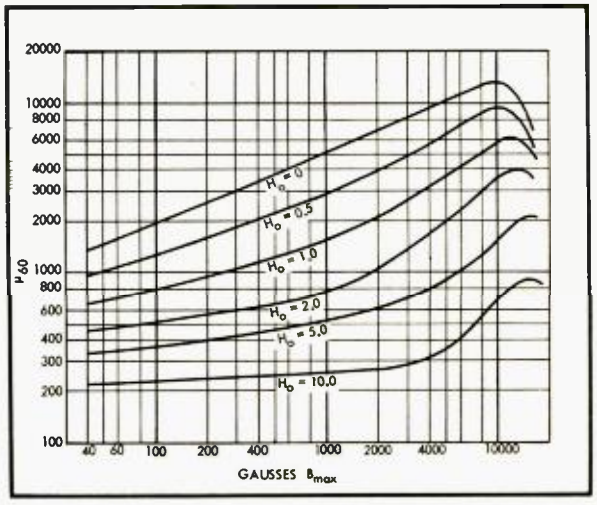


Fig. 2. Flux density vs. Mu. (Courtesy Magnetic Metals Co., Camden, N. J.)

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ically possible, we can make R_1 very low by decreasing it from its customary value $R_1 = R_2$, and increasing R_2. This is tantamount to putting most of the copper losses into the secondary. In transformer vernacular—run the secondary "hot" and the primary "cold." The transformer designer can now proceed as follows:

Keep the new transformer copper efficiency the same as that of the standard, but make new transformer primary d.c. resistance

$$R_A = R_1/K, \qquad (25)$$

where K is the factor representing the degree to which we expect to reduce the size of the standard, and new transformer secondary resistance R_B

$$R_B = R_1(2 - 1/K). \qquad (26)$$

so that $$R_A + R_B = R_1 + R_2 \qquad (27)$$

New transformer primary Q_A is the same as large

$$Q_A = Q_1 = X_A/R_A \qquad (28)$$

where $$X_A = X_L/K \qquad (29)$$

Transformer secondary

$$Q_B = X_A/R_B, \qquad (30)$$

$$Q_B = (R_A Q_1)/[R_1(2 - 1/K)]. \qquad (31)$$

Now total new-transformer dissipation $1/Q_X$ is

$$1/Q_X = (1/Q_1) + K(2 - 1/K)/Q_1 \qquad (32)$$

$$= 2K/Q_1. \qquad (33)$$

$$1/Q_X = 2KR_1/(d_s R_L) \qquad (34)$$

And multiplying (*34*) by (*21*),

$$Q_s/Q_x = K. \qquad (35)$$

The weight ratio of large and small transformer is then

$$W_s/W_x = K^{3/2} \qquad (36)$$

Examine the consequences of this procedure. The total distortion with our standard transformer is

$$D_T = (R_G + R_1)/X_L \qquad (9)$$

and of our modified transformer is

$$D_o = \frac{R_1/K}{X_L/K} = R_1/X_L \qquad (37)$$

And comparing the distortion factors D_T and D_o by dividing (*9*) by (*37*) we have

$$D_T/D_o = 1 + (R_G/R_1) \qquad (38)$$

The intrinsic distortion of the standard transformer is the *same* as that of the smaller transformer. But when the standard is used with a substantial source resistance, it yields more distortion than our new smaller transformer in a zero-impedance output stage.

Here we have a technique that looks very promising. However, having ignored a number of important parameters, we should try to see what practical limits must be assigned to K by studying each neglected parameter:

1. Flux density and non-linear nature of X_L;
2. Power supply regulation at low frequencies;
3. Core loss;
4. Temperature rise of the transformer;
5. Bandwidth; and
6. The Class B_1 high-frequency response and regulation.

1. Flux Density and Distortion

(a) When X_L is reduced by a factor of K, the flux density is generally increased (see Eq. *22*), so it is essential to insure that μ_e in the equation

$$L = 3.19N^2 A \mu_e 10^{-8}/l \qquad (39)$$

where l = length of magnetic path does not fall below the value needed to maintain $L_o = L_s/K$.

(b) It is also necessary now to reconsider the previous formulation for distortion which was based on the supposition that *all* of the magnetizing current was harmonic. Because, as Partridge[8] has shown, the percentage of third and fifth harmonics in the magnetizing current is a function of the operating flux density. Table II summarizes such data.

TABLE II

Typical Silicon-steel Magnetizing Current Harmonic Components with Zero-Impedance Source[9]

B_M Gauss	Percentage of 3rd Harmonic	Percentage of 5th Harmonic
100	4	1
500	7	1.5
1,000	9	2.0
3,000	15	2.5
5,000	20	3.0
10,000	30	5.0

On the basis of this data we shall define K_d as the factor by which the distortion increases when operating at B_o (due to size reduction) rather than B_M (the flux density of the standard transformer). Then

$$D_o = \left(\frac{R_1/K}{X_L/K}\right) K_d = K_d R_1/X_L \qquad (40)$$

and

$$\frac{D_T}{D_o} = \frac{(R_G + R_1)X_L}{(R_1/X_L)K_d} = \left(1 + \frac{R_G}{R_1}\right)\frac{1}{K_d} \qquad (41)$$

If, for example $B_M = 5000$ gauss and $B_o = 10{,}000$ gauss then $K_d = 0.3/0.2 = 1.5$ (neglecting fifth harmonics). Equation (*41*) is therefore a more accurate version of Eq. (*38*).

For help in designing the new transformer, Table III lists likely values of K_d and the corresponding values of R_G/R_1 and $D_T D_o$.

[8] N. Partridge, "Harmonic Distortion in a. f. transformers," *Wireless Engr.* Sept.–Nov., 1942.

[9] R. Lee, *op. cit*, p. 163.

TABLE III

RELATIVE DISTORTION

D_T/D_o	R_G/R_1	K_d
0.75	0.5	2
1.0	0.5	1.5
1.0	1	2
1.33	1	1.5
1.5	2	2
2.0	2	1.5

Values of 1.5 and 2 for K_d are deliberately chosen to represent the probable maximum distortion increase if the flux density doubles due to a choice of $K \cong 2$. Table III indicates that the small transformer produces the same or less distortion than the large, provided K (and thereby K_d) is not made too large.

(c) Since there is usually some degree of output tube unbalance, polarizing d.c. in the primary has two important effects:

(1) the effective μ_e is decreased, and is now obtained from the family of curves in *Fig.* 2 after estimating the ampere-turns per inch, H:

$$H = NI/l \qquad (42)$$

where N = primary turns
I = polarizing d.c. current
l = length of magnetic path, inches

(2) the magnetizing current now contains *even* harmonics as well as odd. It is therefore desirable when reducing the size of the standard transformer that H be kept the same (or smaller). This can be easily accomplished in practice.

2. Power Supply Regulation

Power supply regulation is quite important to the *high-level* low-frequency performance.

(a) In *Fig.* 3 neglect R_G (to be studied later), and R_2 (since $R_2 \ll R_L$). First assume perfect power supply regulation so that the output tubes must furnish the following VA:

$$VA = \frac{E_p^2}{Z} \qquad (43)$$

$$VA = \frac{E_p^2}{R_L} - j\frac{E_p^2}{R_L}\frac{1}{d} \qquad (44)$$

$$VA = P_o - jP_o/d \qquad (45)$$

$$VA = P_o(1 - j/d) \qquad (46)$$

where P_o = real watts audio

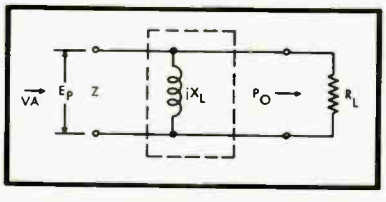


Fig. 3. Low-frequency impedance.

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Equation (45) tells us that at high power levels P_o/d reactive *VARS* will be supplied to the magnetic core. Since the *VA* furnished by the output comes ultimately from the plate supply, it is apparent that distortion is higher at high power levels when using an unregulated power supply.

We can now attempt to establish suitable criteria for $d_o = X_L/(KR_L)$.

The VA ratio between small and large transformers is

$$\frac{VA_x}{VA_s}\,\frac{1-jK/d_s}{1-j/d_s} = \frac{\sqrt{1+(K/d_s)^2}}{\sqrt{1+(1/d_s)^2}} \qquad (47)$$

If we assume certain values of d, we can tabulate (Table IV) the *VA* increase

TABLE IV
VA INCREASE

d_s	d_o	$M = VA_x/VA_s$	10 log M, db
5	2.5	1.055	0.232
3	1.5	1.11	0.45
2	1.0	1.27	1.04
1	0.5	1.59	2.02

demanded of the power supply at high-level low frequencies.

If, for example $d_s = 3$ at lowest useful frequency and is reduced by $K = 2$ (a weight saving of 65 per cent) only 11 per cent more *VA* is demanded from the power supply at that frequency. Under these conditions the measured distortion in the zero impedance circuit at the lowest frequency is found to be unusually low, and *easily comparable* to the distortion figure for the large transformer in a conventional feedback amplifier.

(b) When $R_G = 0$, but the power supply is *not* perfectly regulated, experience indicates that a quite sizeable but less dramatic size-reduction is feasible. Examination of Eq. (41) has suggested to the writer a more modest value of K in this case. Experience has shown that with a choice of $K = 1.4$, a weight saving of about 40 per cent is obtainable with a distortion figure *equal to or lower than* that of the large transformer in an unregulated conventional feedback amplifier.

3. Core Loss

Analysis of the effect of increasing core loss (decreasing R_C) when $K = 2$ indicates a negligibly small change in high-level low-frequency performance, so core loss may safely be ignored except perhaps when $K > 2$. This would be the case where we succeeded in reducing the output transformer to the size of a 60-cps power transformer of the same power rating.

4. Temperature Rise

Since our (low-distortion) conventional output transformer is much larger than its equivalent power transformer of the same rating, it runs "cool," that is its temperature rise is in the approximate range of 10°–20° C.

If we use an approximate equation for temperature rise[10]

$$\theta_o = cP_l/w^{2/3} \qquad (48)$$

where θ_o = temperature rise, °C.
c = a constant
P_l = losses
w = weight

The relative temperature rise of the new transformer will be

$$\frac{\theta_x}{\theta_s} = \left(\frac{W_x}{W_s}\right)^{-2/3} = \left(\frac{1}{K^{3/2}}\right)^{-2/3} = K \qquad (49)$$

So that our new transformer rise for $K = 2$ will be in the range of 20° to 40° C. A temperature rise of 40° to 55° C is permitted for military and commercial transformers, respectively, with Class A (105° C final temperature) insulation. On a thermal basis, therefore, the *conventional transformer may be reduced in weight by at least 65 per cent.*

5. Bandwidth

If we neglect the various winding capacitances and shunt core loss R_C, the following bandwidth equation[11] is informative (see *Fig.* 4)

$$B_T = \frac{f_h}{f_l} = \frac{R_s}{R_p}\,\frac{L_p}{L_s} \qquad (50)$$

where f_h = 3db down high-frequency ($X_s = R_s$)
f_l = 3db down low-frequency ($R_p = X_L$)

$$R_s = R_G + R_1 + R_2 + R_L \qquad (51)$$

$$1/R_p = 1/(R_G + R_1) + 1/(R_2 + R_L) \qquad (20)$$

L_s = total leakage inductance,
X_s = leakage reactance
L_p = primary shunt inductance

The relative high-frequency response is

$$20 \log \frac{1}{1 + jX_s/R_s} \qquad (52)$$

and

$$L_s = 3.2N^2\,\frac{M}{b}\left(d + \frac{a}{3}\right) 10^{-8} \qquad (53)$$

where M = coil mean length turn
b = winding length
d = insulation between windings
a = total copper depth of windings

Substituting the equations for L_p and L_s, into (50) we get

$$B_T = \frac{f_h}{f_l} = C_h \mu_e\,\frac{R_s}{R_p} \qquad (54)$$

where C_h is a complex constant describing the geometry of the core. If $R_G \ll R_1$ we can write

$$B_s = C_h \mu_e\,\frac{R_1 + R_2 + R_L}{R_1} \qquad (55)$$

By substituting R_A and R_B in (55), we get for the bandwidth of the small transformer

$$B_x = C_h \mu_e\,\frac{R_1/K + R_1\left(2 - \frac{1}{K}\right) + R_L}{R_1/K} \qquad (56)$$

$$B_x = C_h \mu_e\,\frac{K(2R_1 + R_L)}{R_1} \qquad (57)$$

Dividing (57) by (54)

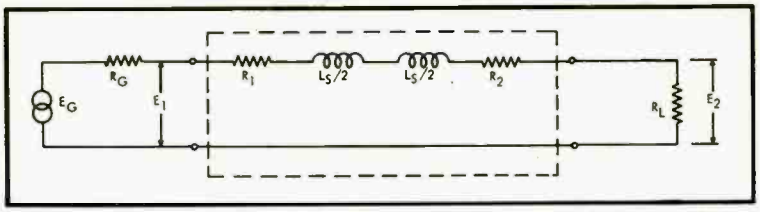


Fig. 4. High-frequency equivalent circuit.

$$B_x/B_T = K\,\frac{R_p}{R_1}\,\frac{(R_s - R_G)}{R_s} \qquad (58)$$

or

$$B_x/B_T \cong K\left(1 + \frac{R_G}{R_1}\right)\left(1 - \frac{R_G}{R_s}\right) \qquad (59)$$

In words, our new transformer in a zero-impedance output stage has *at least K times the bandwidth as the large.*

6. Class B_1 High-Frequency Performance

The "*K*-modified" transformer has important beneficial results in a class B_1 amplifier with zero source resistance and a well regulated plate supply.

(a) The interprimary (half-primary to half-primary) leakage reactance is lower. If $K = 2$, the dreaded "notch" due to switching transients[12] is moved up an octave, approximately.

(*Continued on page 68*)

[10] R. Lee, *op cit.* p. 60. This equation, while intended for large transformers, serves our purpose here.

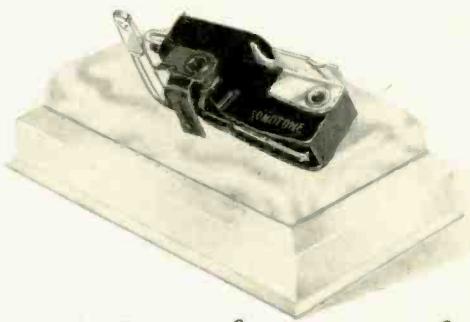
[11] MIT Staff, "*Magnetic Circuits and Transformers.*" Wiley: 1943, p. 484. Also see F. Terman, "*Radio Engineers' Handbook.*" McGraw-Hill: 1943. p. 388, *Fig.* 26.

[12] A. P. Sah, "Quasi-transients in Class B audio-frequency amplifiers." *Proc. IRE*, Nov. 1936.

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AUDIOCLINIC ? ?

JOSEPH GIOVANELLI

FM Limiter

Q. What is the purpose of a limiter in an FM receiver? George Klima, Valley Stream, N. Y.

A. The purpose of a limiter is to remove all amplitude modulation from the signal which is to be fed to following stages. Basically, the limiter circuit is that of an overloaded amplifier. Signal voltage fed to the limiter may vary in voltage because of noise pulses, distortion in previous stages, and other reasons. The limiter plate current reaches its maximum on each cycle of the signal long before the peak voltage of the signal is reached. Consequently, any further increase—such as may be caused by static, ignition, or what not—does not affect the *amplitude* of the output signal. The frequency-modulated signal is fed out to the succeeding stages without any amplitude modulation. If the signal strength is lower than a certain value, called the limiter threshold, the limiter functions as a square-law amplifier and the limiting action is lost. In some circuits, two limiters are used to obtain a further limiting action and consequent improvement in performance.

Shorter Long-Plays

Q. Why are some twelve-inch microgroove records made to play for only sixteen minutes or even less? Frank Geisler, N. Y.

A. The limitations of the dynamic range of a record are primarily caused by the thickness of the groove walls. This is especially true at bass frequencies. This is caused by the fact that when the volume is very high, the distance traversed by the cutting stylus is such that it tends to break through the groove wall and partially modulate the adjacent groove causing a phenomenon known as echo. It can be clearly seen, then, that if the groove walls are very thin, it becomes necessary to compress the dynamic range to a serious extent. By increasing the thickness of the walls the dynamic range is kept intact but, since such grooves take up more space, there must be fewer of them, resulting in shorter playing time. Another reason for doing this is that as the recording stylus nears the center of the record, high-frequency attenuation takes place, despite slope-control equalizers. To maintain frequency response as well as dynamic range uniformly over the entire disc, the stylus is not permitted to approach the center as closely as is the case with standard records. This also causes the playback stylus to describe a relatively small arc, so that it traces more exactly the path of the recording stylus, minimizing tracking error and its consequent distortion.

Audio AVC

Q. When listening to records or FM, I have noticed an annoying variation in volume level. Would it be commercially feasible to incorporate in new amplifiers a circuit similar to AVC/AGC that would boost or reduce the gain so that at a given setting of the volume control, regardless of the original recording level, all music would come out of the loudspeaker at the same intensity level? J. Klein, B'klyn

A. Before answering this question directly, it is well to consider some of the factors which cause the level of the music you hear to differ from station to station and selection to selection: 1) There is a difference in signal strength of the stations, depending upon the moisture content of the earth, the distance between transmitter and receiver and other conditions; some stations are always stronger than others. The AVC/AGC in the tuner or receiver does not entirely overcome these differences. 2) The policies of the stations may differ somewhat as to the level they wish to use when reproducing music; some believe that the music should be lower than the speech level so that commercial announcements will tend to gain the attention of the listeners. 3) Different pieces of music and, indeed, different performances of the same piece of music vary in dynamic range; some may be uniformly loud, others uniformly soft. 4) Differing levels are used when recording discs and tapes, even for the same dynamic range to be produced. It is difficult for the broadcast engineer to know exactly where the peaks are to come and so, quite often, he must set his equipment in such a way as to allow for the maximum possible loudness; if such a level is not reached, even very loud passages may be reproduced more softly than the listener would like to hear them. 5) Sometimes the variations are in the *apparent* loudness of the records rather than in actual sound level. Microphone placement as well as the type of material being listened to can cause tremendous differences in apparent loudness.

We do not feel that a circuit could be designed which would overcome all of these problems; although uniform volume were being produced, the ear would still hear differences in apparent loudness. However, such evenness of volume would be esthetically undesirable since music, speech, and other program material would be rendered hopelessly monotonous by the loss of all dynamic contrasts.

Phase Inverter

Q. Please describe the principles of operation of a split-load phase inverter.
Carl Pollack, Natick, R. I.

A. This type of phase inverter, or any other, is generally used to feed push-pull stages from a "single-ended" source. To do this, the circuit must be such that when one of the push-pull grids is being made positive with respect to its static bias, the other is being made negative, with the reverse being true on the other half of the cycle. The split-load phase inverter is shown in *Fig.* 1 and is what its name implies. In a conventional triode circuit, the full load is placed in the plate; in a cathode follower, it is in the cathode circuit. In this arrangement, however, half of the load is in the plate circuit, the other half in the cathode circuit. In operation, when the grid of the phase inverter, V_1, is made negative with respect to its static bias, the flow of plate current decreases, causing a decreased voltage drop across R_2. This causes the plate to become more positive which, in turn, causes the grid of V_2, to which it is connected, to become more positive also. This decrease of plate current also causes decreased current to flow in the cathode load, R_3–R_4, which causes the cathode to become more negative. This, in turn causes the grid of V_3, to which it is connected, to be driven negative. Notice that the cathode load is made up of two resistors in series, R_3 and R_4, with the bottom of the grid resistor, R_1, connected to their junction. Thus it can be seen that the voltage drop across R_3 will provide the necessary grid bias for V_1. When the grid of the phase inverter, V_1, is made positive with respect to its static bias, those circuit elements which were made positive before are now made negative instead and those which were made negative before are now made positive.

Two Speakers in one Cabinet

Q. What is the difference in performance between having one speaker in a given size enclosure and having two speakers in the same size enclosure?
Dean M. Tonelli, Chicago, Ill.

A. In the first instance, let us assume one speaker in the enclosure. Let us further assume that a program level of 10 watts is being fed to this speaker, causing the voice coil to move x inches during any one cycle. Then, a second speaker is introduced into the circuit, and we shall assume it to be identical with the first with respect to size, impedance, frequency response, and manufacturer. It is necessary that this second speaker be phased properly with respect to the first. Assuming the same power level of 10 watts, 5 watts will now be delivered to each speaker. The loudness level as heard by a listener will be the same. However, the cones will now travel $x/2$ inches per excursion. Here, then, is the basic difference. Although the acoustic power produced by the two speakers in the

(*Continued on page 69*)

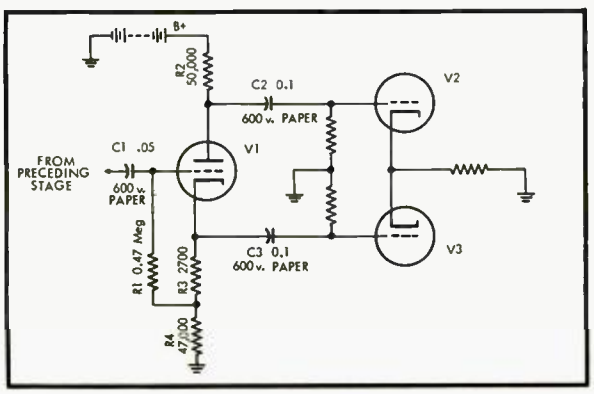


Fig. 1.

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Adjust the separate *bass* and *treble tone controls* to correct for the characteristics of your loudspeaker and for the acoustic characteristics of the room. Choose settings which, in your total system, create the proper sense of aural balance. Now reduce the loudness setting to a level, lower than the normal listening level in your room. Note that the full bodied, lifelike quality you experienced at high listening level has disappeared. This is typical of human hearing since it loses sensitivity to very low and very high pitched notes as the sound level is reduced. With all other controls unchanged, switch quickly through the four positions of the loudness contour control until you find the one which most nearly duplicates the full bodied sound you enjoyed at high level.

Turn the loudness control up to the level at which you wish to listen. The controls are now properly organized and your system should perform at its very best!

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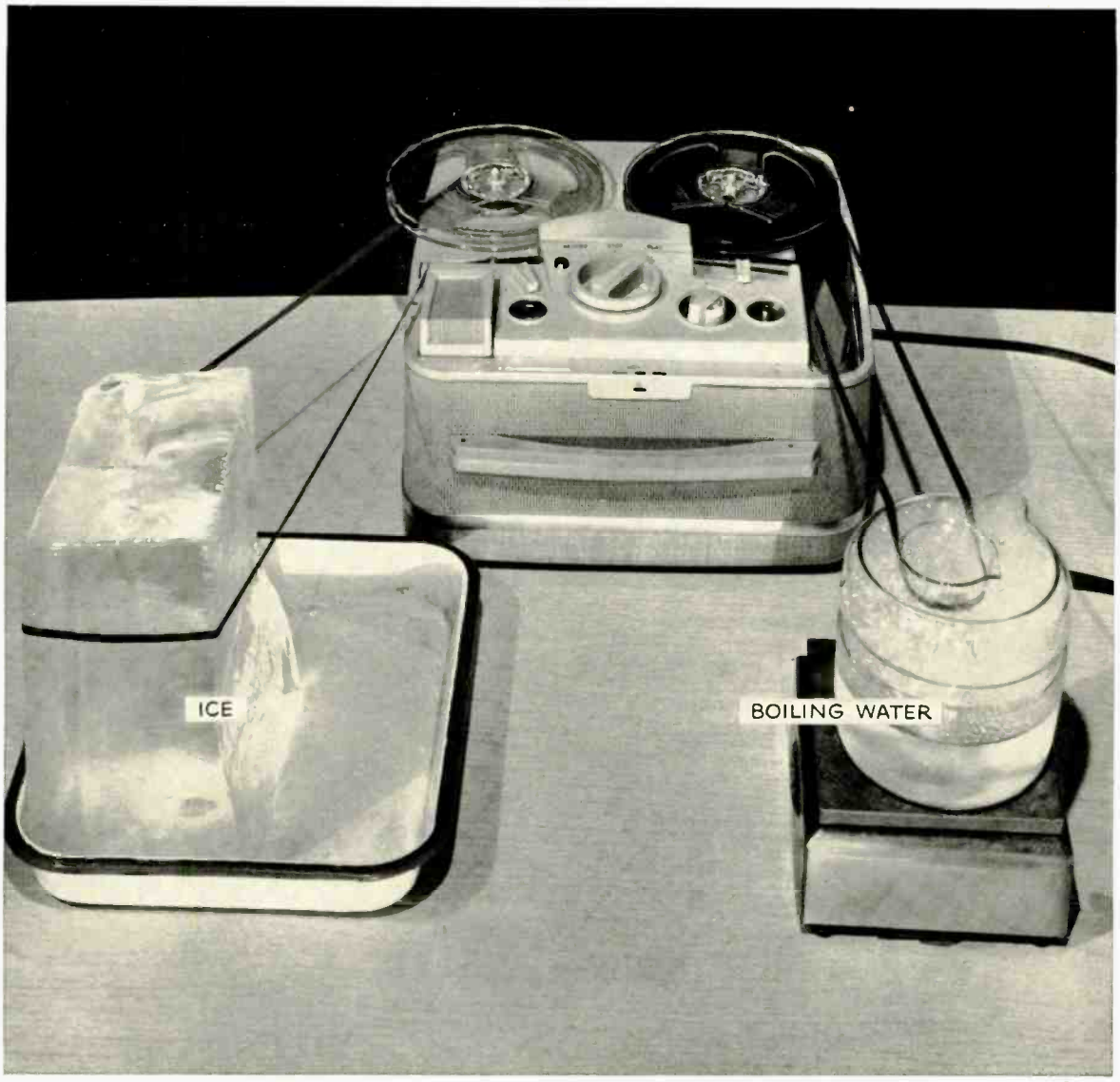
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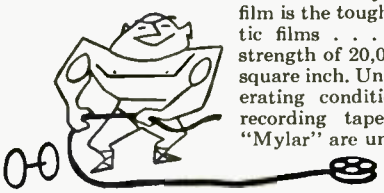
Magnetic recording tapes made with Du Pont "Mylar" last longer, need no special care in storing —the tape torture test pictured above shows why. In this laboratory demonstration, tape made with "Mylar" is run from the recorder into boiling water and around a cake of ice. Even extreme conditions such as these cause no change in strength, flexibility, and dimensional stability of "Mylar".

Tapes made with "Mylar" contain no plasticizer . . . won't dry out or become brittle with age. That's why these new tapes are ideal for home use, industrial, religious, legal and professional recording.

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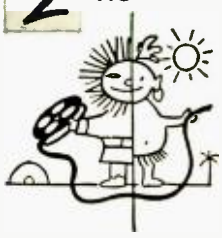
with new Du Pont MYLAR® offer you all these advantages

1 NO MORE BREAKAGE



Du Pont "Mylar" polyester film is the toughest of all plastic films . . . has a tensile strength of 20,000 pounds per square inch. Under normal operating conditions, magnetic recording tapes made with "Mylar" are unbreakable.

2 NO CHANGE IN DIMENSION DUE TO WEATHER



Radical differences in temperature and humidity have no effect on tapes made with "Mylar". In radio and TV broadcasting, timing of programs is unaffected when recorded in one part of the country and played back in another.

3 NO MORE STORAGE PROBLEMS



Because tapes made with "Mylar" are unaffected by extremes of temperature or humidity, no special care is needed in storage. When completely immersed in water for a week, "Mylar" absorbs less than ½ of 1% of its weight in moisture.

4 LONGER LIFE



The high strength of "Mylar", plus the fact that this remarkable film contains no plasticizer to dry out or become brittle with age, makes possible tapes that last longer. Material recorded today can be reproduced faithfully many years from now.

5 ECONOMY, TOO



The amazing strength of "Mylar" also permits extra-long playing time, extra economy. With "Mylar", tapes only two-thirds as thick as most ordinary tape can be used, giving essentially a reel and a half of tape on *one* reel.



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Preamplifiers and Control Units

EDGAR M. VILLCHUR*

Sound—Chapter 6

A discussion of the reasons for preamplifiers, their requirements and how they fulfill them, and the circuit configurations that provide boost and cut of either treble or bass frequencies.

THE SIMPLEST ELECTRICAL phonograph system is one in which a very high output pickup is connected directly to the grid of a power amplifier tube. Crystal pickups with outputs of 3 or 4 volts, for example, are sometimes used to drive the grid of a 50L6 output tube (the 50L6 is designed to operate with relatively small input voltages) without intermediary voltage amplifiers.

Normally, however, the output of the pickup, whatever the type, is fed to a voltage amplifier. When this voltage amplifier is an extra stage, not used for other inputs such as tuner signals, it is called a *preamplifier*. Magnetic pickups require preamplifiers because of their low output voltage. Magnetic pickup voltages in the range between one and fifty millivolts are amplified to values of the order of one volt.

Special Tasks of the Preamplifier

The first job of the preamplifier, as described above, is to amplify the pickup voltage, without distortion. Unlike voltage amplifier stages in the amplifier proper, the preamplifier works with very small signals. Any stray noise or hum induced in the pickup, the pickup lead, the circuit components, or the tubes themselves may compete with the signal itself in magnitude, at least to the extent of providing an annoying noise background.

We have seen that FM broadcast standards for signal-to-noise ratio require that the noise be at least 60 db down from the signal, that is, that it be no more than one-millionth of the power of the signal. When the signal itself is of the order of a small fraction of a microwatt the power of stray hum and noise in the circuit must be kept low indeed in order not to intrude.

One special quality of good preamplifiers, therefore, is that they have very low noise and hum. Power amplifiers with signal-to-noise ratios of 80 db (100 million to one) or better are not too unusual, but we must lower our standards for phonograph preamplifiers, especially when using very low output pickups.

The next job of the preamplifier is to introduce the correct frequency discrimination to compensate for the bass attenuation and treble boost in the recorded signal—to *equalize* the output of the magnetic pickup. Since all records have not been made with the same frequency characteristics, most high fidelity preamplifiers have facilities for switching from one type of equalization to another, shifting the bass turnover and treble pre-emphasis frequencies, and in some cases the rate of boost or slope.

These switching facilities may be fairly simple—a single knob with four or five positions—or fairly complicated, with separate switching of bass and treble transition frequencies. Considering the fact that factors beyond the control of the phonograph operator, such as microphone position, recording studio acoustics, and so on, may have a greater effect on the over-all sound than the differences in recording characteristics between two companies, it seems sensible to favor the simpler arrangement. The general tone controls may be used to 'touch up" the sound to its most natural form, in any case.

The frequency response of a preamplifier is described by the curve of its equalization. The excellence of preamplifiers in this respect is indicated by the accuracy with which they adhere to the correct equalization curve. It is obvious that describing the frequency response of a preamplifier in terms of frequency extremes—20 to 20,000 cps, for example—would tell us nothing useful about the performance characteristics of the unit. What we want to know is whether the frequency response of the preamplifier is within, let us say, one db of the proper equalization at all points of the curve.

When the desired frequency response curve of a particular audio component happens to be flat (as in the case of a velocity pickup, power amplifier, or loudspeaker), it is unfortunate that the meaning of the phrase "frequency response" sometimes departs suddenly, and a meaningless recitation of frequency limits takes its place. But it is no less true here, than in the case of the equalized circuit, that a meaningful description of frequency response must tell us how accurately the output conforms to

* *Woodstock, N. Y.*

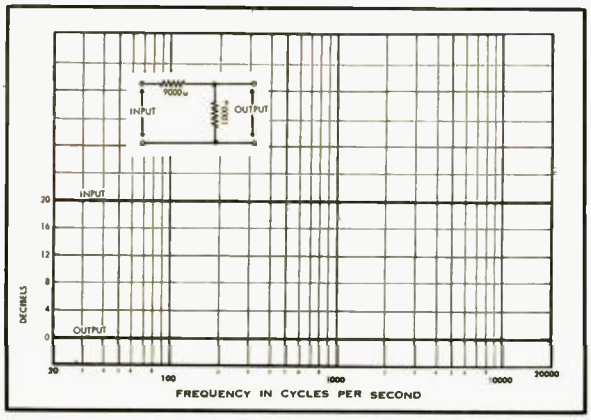


Fig. 6—1. Resistive voltage divider. The input is attenuated by a factor of ten (a 10 to 1 voltage ratio is 20 db), but there is no frequency discrimination.

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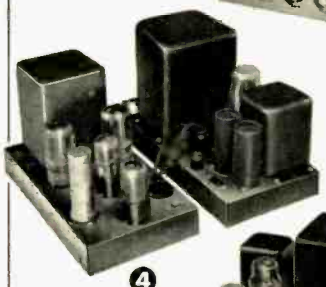


❹ Heathkit Williamson Type HIGH FIDELITY AMPLIFIER KIT

This amplifier employs the famous Acrosound TO-300 "Ultra Linear" output transformer, and has a frequency response within +1 db from 6 cps to 150 Kc at 1 watt. Harmonic distortion only 1% at 21 watts. IM distortion at 20-watts only 1.3%. Power output 20 watts, 4, 8, or 16 ohms output. Hum and noise, 88 db below 20 watts. Uses 2-6SN7's, 2-5881's and 5V4G. Kit combinations:

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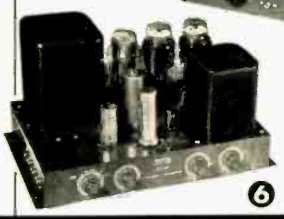
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❻ Heathkit 20-Watt HIGH FIDELITY AMPLIFIER KIT

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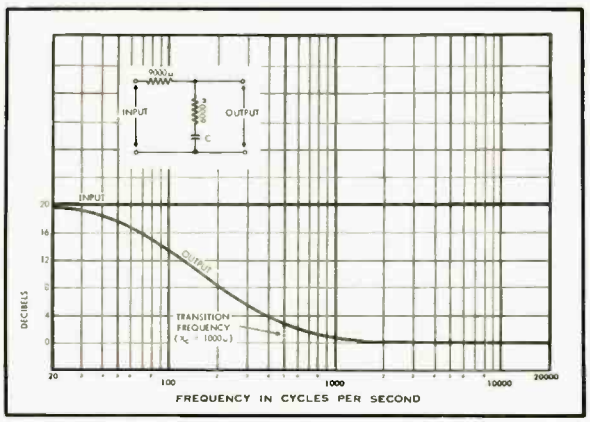
Heathkit construction manuals are full of big, clear pictorial diagrams that show the placement of each lead and part in the circuit. In addition, the step-by-step procedure describes each phase of the construction very carefully, and supplies all the information you need to assemble the kit properly. Includes information on resistor color-codes, tips on soldering, and information on the tools you need. Even a beginner can build high quality Heathkits and enjoy their wonderful performance.

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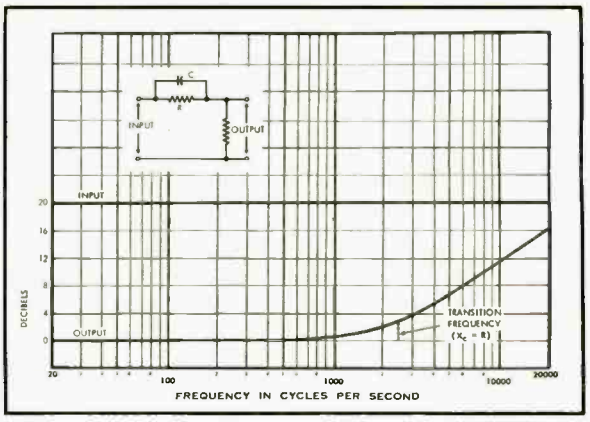


Fig. 6—2 (left). Resistor-capacitor voltage divider, and resulting bass boost. Fig. 6—3 (right). Treble boost circuit.

the ideal (in this case flat) at every point of the curve.

In summary, then, the preamplifier must amplify the magnetic pickup output voltage to a value comparable to the output of the tuner or of a crystal pickup—roughly half a volt to a volt—without the introduction of significant distortion or noise, and it must accurately equalize the output of the pickup to the reciprocal of the frequency characteristic of the particular record. High quality preamplifiers may be expected to keep harmonic distortion at a small fraction of one per cent, to keep the noise at least 60 db below the signal, and to provide an equalization curve accurate within half a db or so of the theoretical curve, over the entire audio spectrum.

The preamplifier should also provide the proper resistance "termination" for the pickup, as discussed in a previous chapter.

Frequency Discriminating Circuits

Frequency discriminating circuits—equalizers for preamplifiers, or variable tone controls—may be of the feedback or direct type, but in either case the basic circuit element is the *voltage divider*.

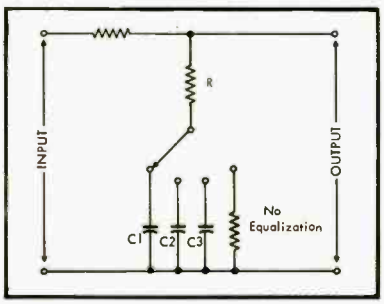


Fig. 6—4. Circuit for bass boost equalization with provision for changing transition frequency. The capacitors have different values, such that $X_c = R$ at the desired turnover frequency.

A resistive voltage divider is illustrated in *Fig.* 6—1. If the series resistor is 9,000 ohms, and the shunt resistor is 1,000 ohms, as shown, the output voltage of the network will be just one-tenth of the input voltage, or 20 db down. Since resistors do not change their value with frequency, the same attenuation will occur at all frequencies. The frequency response of this resistive circuit is plotted in the graph of *Fig.* 6—1; it can be seen that the "curve" for output voltage has not changed from the curve for input voltage, except that it is reduced in amplitude by a factor of ten.

Now consider the circuit of *Fig.* 6—2, in which the lower arm of the divider has had a capacitor added in series. At very high frequencies the *reactance* of the capacitor (analogous to a.c. resistance) is negligible—the capacitor acts as though it were shorted out. The attenuation of the circuit at these frequencies will therefore be substantially the same as in *Fig.* 6—1—by the full factor of ten, or twenty db.

As the frequency is lowered the reactance of the capacitor will increase. It will begin to affect appreciably the impedance of the lower arm of the voltage divider, and the ratio of the two arms: thus it will also affect the amount of attenuation.

At some lower frequency the reactance of the capacitor will be equal to 1,000 ohms, the value of the resistor in the lower arm. This is taken to be the point at which the frequency discriminating characteristics of the circuit take hold (although it can be seen that the change is gradual), and is called the *transition frequency*. In the case of the circuit under discussion it is the frequency at which bass boost is considered to begin, and corresponds to the bass turnover frequency of the recording characteristic.

As the frequency is lowered further the total impedance of the voltage divider's lower arm increases more rapidly. The attenuation of the circuit is decreased progressively until finally, at very low frequencies, the voltage divider lets through practically all of the input voltage, as illustrated in the graph of *Fig.* 6—2.

We call such a circuit a "bass boost" network, but obviously we have really boosted nothing. What we have actually done is to attenuate a whole band of frequencies, and then to selectively let a part of the attenuated frequency spectrum back in.

The same circuit configuration as that of *Fig* 6—2 may also be used for treble attenuation, by choosing the circuit values so as to shift the entire curve to the right (upwards in frequency). A treble boost or bass attenuating network, on the other hand, must work in an inverse manner. Application of the same sort of analysis to the circuit of *Fig.* 6—3 as was used above will show the reader why the circuit of *Fig.* 6—3 can be used for treble boost or bass attenuation.

The task of providing switching facilities for choosing different turnover frequencies now appears quite simple. All we have to do is to change the value of capacitor for each switch position, as is done in the circuit of *Fig.* 6—4.

(*Continued on page 49*)

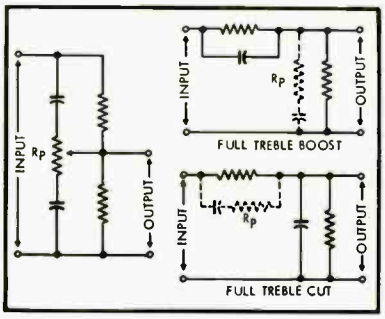


Fig. 6—5. Continuously variable treble tone control. Equivalent circuits for maximum boost and cut are shown, with significant elements at that point shown in heavy line.

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Equipment Report

12-Watt Munston Amplifier-Preamplifier—Miratwin MST-2D Magnetic Pickup Cartridge—Hermon Hosmer Scott 311 FM Tuner

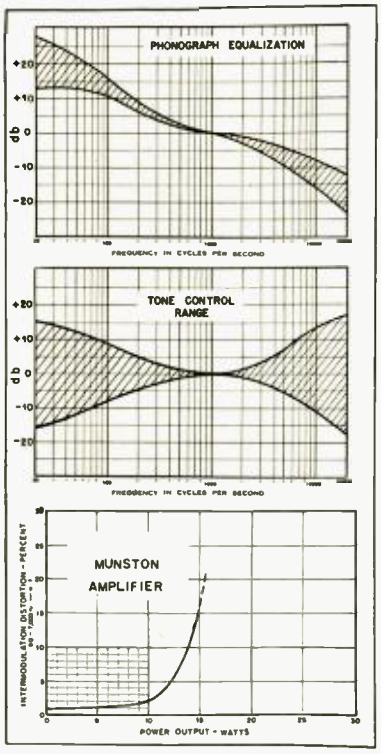
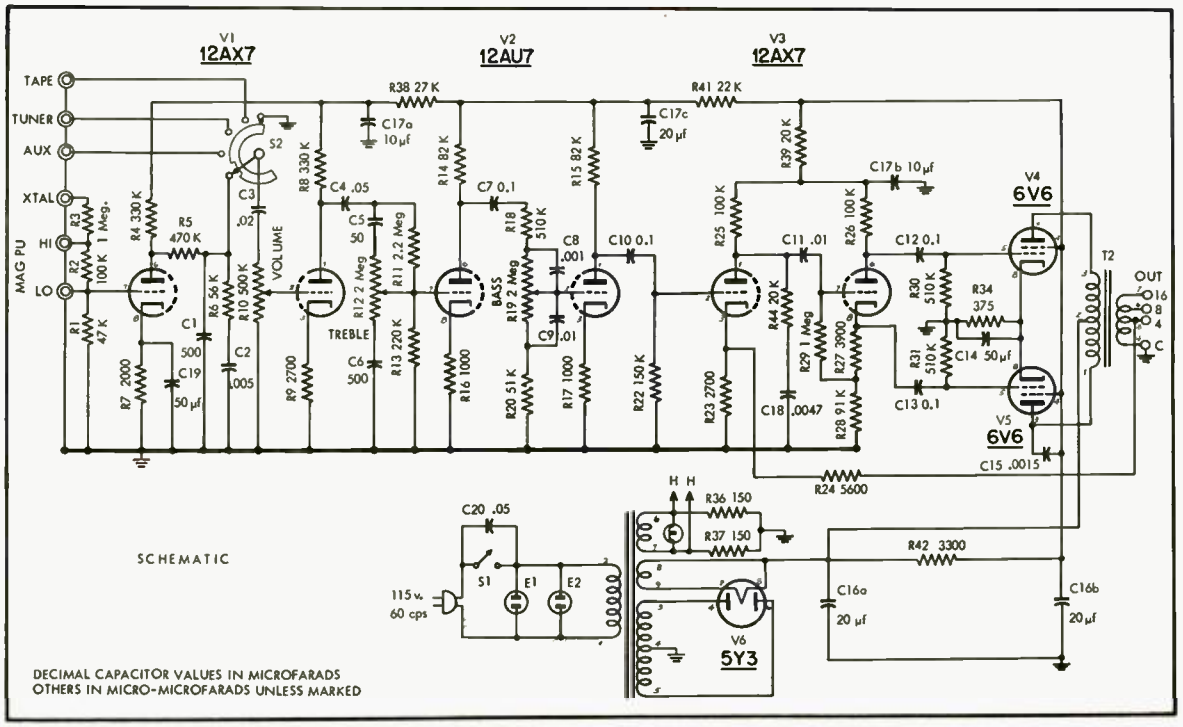


Fig. 1. (left). Performance curves for the 12-watt Munston Amplifier. Fig. 2 (below). Over-all schematic of the Munston.

NEWCOMERS to the hi-fi fold who have begun to collect records since the introduction of the long-playing microgroove type in 1948 have increasingly less need for a variety of phonograph equalization curves in their equipment than the old timer who has been collecting records for many years. It has long been the prediction of this observer that when there was sufficient standardization of recording characteristics there would appear an amplifier which was designed to accommodate the basic curve—such as the RIAA has become, practically—with such other variations as might be required being supplied by "touching up" with the bass and treble tone controls. With the introduction of the 12-watt Munston Amplifier, this department modestly admits, "We told you so." In all seriousness, however, the design philosophy of this amplifier offers several features which make it possible for the music lover to fulfill his desires for a suitable amplifier at a relatively low cost.

While there is no denying the need for a wide variety of recording characteristic curves in an amplifier to be used by the veteran record collector who has all kinds of records perhaps dating back to the twenties, it is equally certain that a collection of LP records can be played with a reasonably close match of characteristics provided the amplifier has a properly adjusted phono curve built into it, and suitable flexibility of the tone controls. AUDIO has long maintained that exact certainty of the equalization to published curves was not the panacea that it would appear to be—there are too many other variables. Carried to extremes, the "hypercritical" listener might insist on slavish duplication of all possible curves. He would then set the controls to correspond to the curve allegedly employed by the recording company in making the original tape and sit back and listen, even though the music didn't sound "right." If we may assume that the listener's system were perfect, this might be a possible solution. But there is always the possibility that the monitoring speaker in the mixing booth could be deficient in bass, for example, and the engineer would therefore boost the bass in the recording so it sounded right *in his monitoring speaker*, which would make it overbassy in a proper system. Or perhaps the microphone position was not ideal, and compensations were introduced to make it sound like the producer wanted it. In any case, the listener doesn't *have* to listen to it with the specified curve—if it is not exactly to his liking, he should make changes in his settings until it is.

The Munston amplifier has only one phonograph position on its selector switch—a position which gives a medium amount of bass boost and a fixed rolloff of approximately 9 db at 10,000 cps. On the TREBLE control, four designations are indicated—points where the control should be set for four specific curves. Similarly, the phono position introduces a fixed amount of bass boost, and marked points indicate where the BASS control should be set to give a curve corresponding to the markings. With this type of equalization, the listener is encouraged to "cheat" the controls slightly in the vicinity of the indicated point if he feels that the reproduction is not perfect—



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Fig. 3. Satin black case and brushed brass escutcheon present "decorator-type" appearance to the Munston Amplifier.

assuaging his conscience, if he must, with the excuse that "The knobs are probably not set right anyhow."

The response curves obtainable from the unit in the phonograph position are shown in the upper section of *Fig.* 1 over the range of indicated curves—further equalization may be obtained by going beyond the indicated points, both above and below the shaded portion. The tone-control action —in reference to any of the three high-level inputs—is shown in the center section, and the IM distortion is shown in the lower section. *Figure* 2 shows the schematic of the amplifier, and *Fig.* 3 portrays the external appearance of the unit, which measures 11¾ in. wide by 9¾ in. deep by 4 in. high.

Performance

Sensitivity of the amplifier is relatively high, with an input of 2.4 mv giving the standard 1-watt output on phonograph, and an input of 25 mv giving the same output on the high-level inputs, both with the volume control at maximum. Hum and noise was measured at 66 db below 1 watt at normal settings of the volume control and with the tone controls flat. Strangely enough—but a plus feature rather than minus—the hum and noise measured the same whether at phono or high-level settings of the selector switch, both inputs being shorted.

Three phono input jacks are provided—accommodating both low- and high-level magnetic cartridges and crystals or other amplitude-responsive pickups. Three high-level jacks accommodate tuner, tape, and auxiliary inputs, as indicated on the selector switch. 4-, 8-, and 16-ohm outputs are provided, and the amplifier is stable with practically any type of output load. Power consumption is 62 watts at the 1-watt output.

For the music lover who is looking for a maximum of simplicity and sufficient ease of operation that the distaff side of the family can soon learn to feel comfortable with the "system," the new Munston seems to be a practical answer, for it does give good listening quality and it is easy to operate. Added to this is a neat brushed brass escutcheon fronting a satin black case which provides adequate ventilation and furnishes the *is* for the beauty that *does*.

M-21

MIRATWIN MST-2 MAGNETIC PICKUP CARTRIDGE

The uniformly high quality of magnetic pickups already on the market might well seem to act as a deterrent to any manufacturer who might contemplate introducing another, but the new Miratwin was introduced nevertheless, and is likely to entrench itself firmly amongst the others because of some of its features.

The Miratwin—built by the manufacturers of the Miracord XA-100 record changer and the Miraphon XM-110A manual record player—comes in two types, depending on the styli supplied. The MST-2A is equipped with two sapphires, and the MST-2D is equipped with a sapphire stylus for standard grooves and a diamond for microgrooves. Both models are otherwise identical, and consist of two electrically and magnetically separate units permanently mounted back to back, as in *Fig.* 4, and carried in a mounting that switches electrical outputs as the pickup assembly is rotated so that the leads from the pickup housing do not twist back and forth with rotation of the pickup. A separate connecting lug on the mounting permits grounding the frame through the usual third pin on the pickup housing.

The stylus assembly of each of the pickup units may be removed easily using only one's fingernails, and when replaced is seated accurately because of a locating tab. Thus the styli can be changed easily by the user without the need for returning the pickup to the dealer or factory. The stylus shoe has sufficient vertical compliance to prevent damage in case the pickup is dropped on the record.



Fig. 4. The new Miratwin magnetic pickup cartridge.

As should be expected from a high-quality pickup, response is flat within ±2 db from 20 to 18,000 cps on LP Vinylite records, and from 20 to 22,500 cps on shellac 78's, using the correct stylus for each, the usual increase in the high end on shellac pressings is, of course, due to decreased compliance of the record material over the softer Vinylite.

Using a Cook Series 10 test record with a stylus velocity of 9 cm/sec at 1000 cps, the output of the LP side was measured at 49 millivolts, which matches the advertised claim for 55 mv at a 10-cm/sec stylus velocity; similarly, measured output for the same record using the standard stylus was 41 mv—both values being relatively high. With the microgroove stylus, a peak of about 1.1 db was noted at 17,000 cps, and output was down 3.3 db at 20,000 cps, the highest recorded on the Cook disc. Inductive hum pickup was almost unmeasurable—being of the same order of magnitude as that usually found with moving-coil types with impedances of the order of 2 ohms or so. No condition could be found where hum picked up from the phonograph motor could be heard in the loudspeaker with amplifier controls set for normal program output. Yet the impedance of the Miratwin is approximately 1450 ohms on the LP side, 910 on the standard. This is composed of inductances of 385 and 248 millihenries for LP and 78, respectively, and resistances of 1400 and 875 ohms for the two sides. Stylus compliance is stated to 4.2×10^{-6} cm/dyne, which is about normal for a high-quality magnetic pickup, and effective mass is listed at approximately 3 mg, which is also about normal.

Mounting is simplified by the construction of the cartridge, which is held in the "chassis" by the shaft of the turnover knob. The entire pickup assembly can be removed from its holder by pulling the knob and shaft out, allowing the unit to be lifted out and giving access to the holes for the mounting screws, which are furnished. Slotted holes in the holder provide some latitude in mounting.

The Miratwin tracks without distortion up to stylus velocities of 20 cm/sec (the highest levels of tones available on discs for testing) and shows no audible distortion of records with stylus velocities as high as 28 cm/sec. Needle chatter is desirably low, and there is no apparent magnetic pull exerted against a ferrous turntable to increase stylus force when only one record is between stylus and platter.

The cartridge has a total weight of 18 grams, and a load resistance of 50,000 ohms is recommended, resulting in a practical limit of 200 μμf for the connecting leads—which means about eight feet of the usual low-capacitance microphone cable (25 μμf/ft). The recommended stylus force for changers is 8 grams, reducing to 6 grams for manual turntables with high-quality arms.

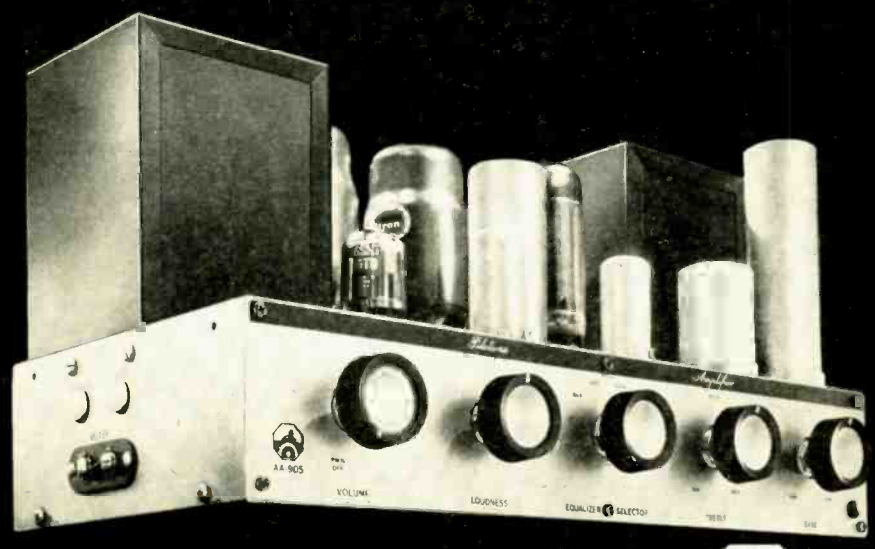
The instruction booklet supplied with each Miratwin cartridge includes a serially-numbered machine-run response curve showing output at eight frequencies resulting from actual measurements, thus showing the user what he has a right to expect from his pickup.

With the relatively high output and very low hum pick-up, the Miratwin cartridge is especially well suited for any installation where a strong a.c. field has been causing trouble, but on the count of listening quality alone it must be considered one of the better-quality magnetic pickups.

M-22

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SCOTT 311 FM TUNER

Practically any good FM tuner on the market for home-music-system use now boasts of a sensitivity that would have been impossible five years ago, so that it is no longer enough that we say that "such-and-such a tuner has a sensitivity of less than five microvolts" to make it a good buy. Sensitivity it must have, of course, but that is almost taken for granted. More important is the quality of reproduction, the freedom from drift, and the reliability of performance.

Hermon Hosmer Scott has always had a reputation for making fine products, and even though the 311 FM tuner is low priced —in comparison with other Scott tuners—it turns in a performance and quality report that is enviable. Sensitivity is claimed to be 3 μv for 20 db of quieting; automatic gain control applied to the r.f. and first i.f. stages maintains uniform output over a wide range of input signal intensity; wide-band design ensures drift-free reception.

Following the publication of two papers from M.I.T. a few years ago, several manufacturers have reduced the findings of the laboratory to practical and manufacturable designs. To improve the tuning characteristics of FM receivers and to reduce the necessity for micrometer adjustment of the tuning for optimum sound quality, a wide-band ratio detector circuit—the subject of one of the M.I.T. papers—is employed in the 311. The detector circuit has a bandwidth of some 2 megacycles, following an i.f. amplifier with a 150-kc pass band. Thus the i.f. amplifier is the governing factor with respect to selectivity, and minor variations from the absolute center of the discriminator pass band do not cause a degradation of quality. With this type of circuit, the selectivity can be considerably greater than with conventional circuits, if properly engineered, and there is no recurring signal from stations which are

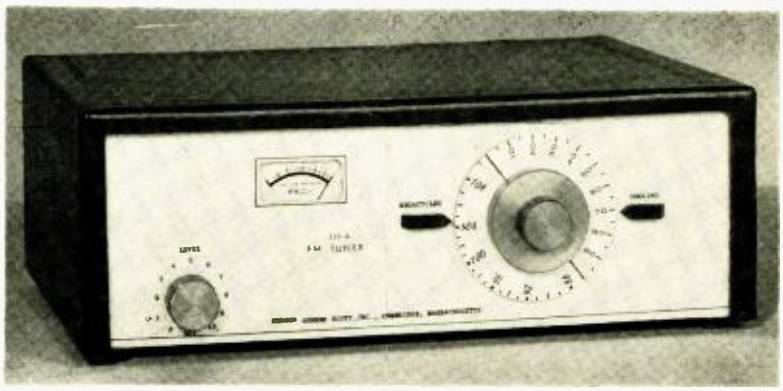


Fig. 5. Hermon Hosmer Scott's new 311 FM Tuner is compact, mounts in an opening 4 1/16 by 12⅛ inches, and is 8½ inches deep.

"detected" on the returning slope of the discriminator curve. This results in a true "one-spot" tuning which is not particularly critical. With a sensitive tuning meter, the set becomes as simple to tune as the garden-variety AM radio.

The Scott 311 tuner, shown pictorially in *Fig.* 5 and schematically in *Fig.* 6, is of simple, if rather modern, styling. The panel is gold finished, the tuning dial is of transparent plastic with white lettering, and is illuminated internally, and the dial index pointers are of red plastic. The large outer knob is directly coupled to the tuning capacitor shaft for fast rotation, while the smaller knob is a vernier for fine tuning. The tuning meter is very sensitive, and because of its low damping the optimum tuning is located readily. The gold-finish knob at the lower left corner of the panel controls a.c. power and volume—if the output were to be fed to a control amplifier, this control could be used only for level setting, with a.c. power being controlled from the other unit. The tuner may be mounted in the user's own cabinetry, or may be housed in a metal accessory case for table-top or bookshelf use. It combines neatly with the Scott 121-B Equalizer-Preamplifier, as both have the same size panel and the same styling.

As will be noted from the schematic, the tuning meter is located in the plate circuit of the first tube—which is a cascode r.f. stage—and the a.v.c. voltage is fed to this tube from the limiter circuit. While most tuners employing the ratio detector do not also employ limiters, this is usually an economy measure, for when limiters are used—there are two in the 311—the ratio detector performs admirably. Because of the wide-band detector, there is no need for automatic frequency control, and with temperature-compensated circuitry there is a minimum of drift anyhow. Under test, the tuner was set to a New York station at the beginning of a week and properly tuned when the set was fully warmed up. Thereafter it was turned on and off daily for seven days with no further adjustment, and the station remained perfectly in tune with excellent tone quality.

A practical test of sensitivity is shown by satisfactory reception at our Long Island location from WNHC in New Haven —a distance of approximately 55 miles and at an angle of 120 deg. from the main axis of a TACO six-element FM Yagi antenna. This seems to indicate a completely satisfactory sensitivity and stability, for the station was received consistently several evenings in a row.

As is usual with modern tuners, the 311 is self powered, using a 6X4 rectifier and adequate resistance-capacitance filtering. The tuner circuit uses a 6BQ7A as a cascode r.f. stage, a 6U8 as oscillator-converter, three 6AU6's as i.f. amplifiers and limiters, two crystal diodes in the ratio detector circuit, and a 12AU7 as audio amplifier. Considerable "flat" feedback is applied over the audio stages to provide a low-impedance output, permitting the use of a relatively long connecting cable, if necessary, without high-frequency attenuation.

From a practical standpoint in day-to-day use, the 311 tuner appears to have performance which belies the simple appearance of the chassis and panel, and is quite likely to surprise anyone who studies its characteristics closely.

M-23

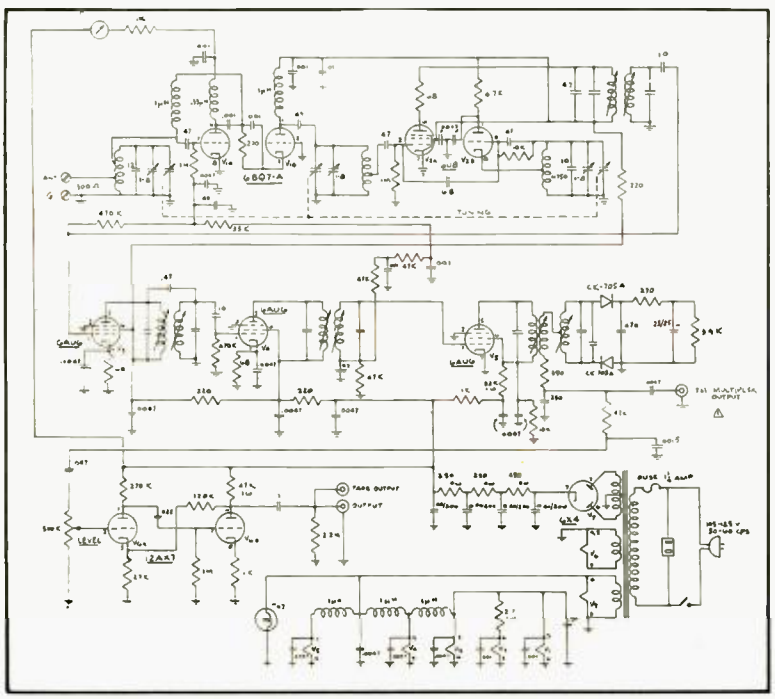
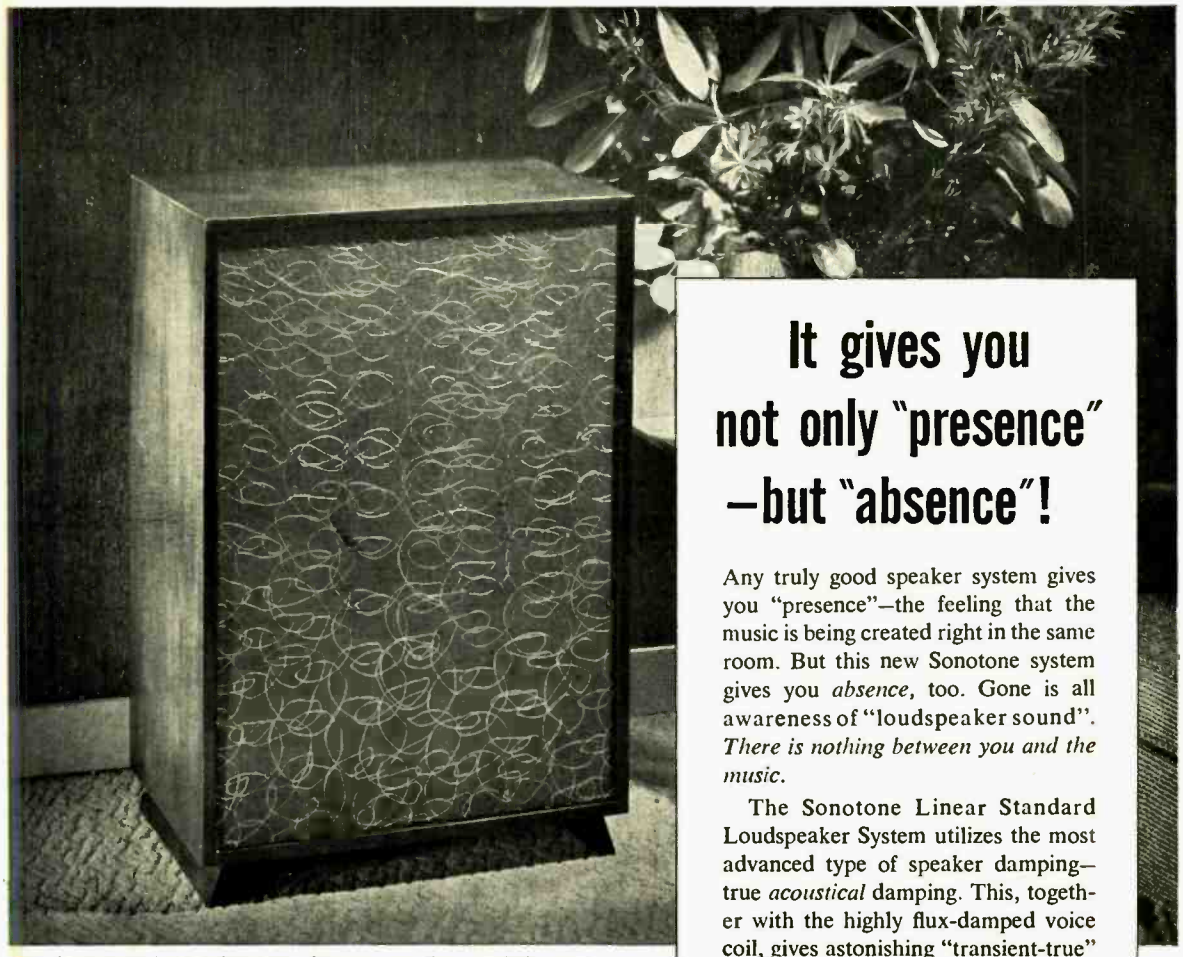


Fig. 6. Schematic of the Scott 311 FM Tuner.

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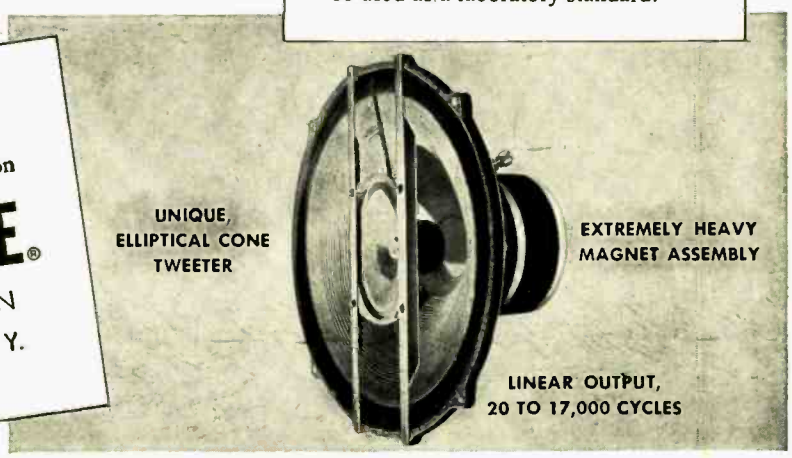
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JAZZ By...JEAN

"This is Jean Shepherd—we have records . . ."

SO IT LOOKS LIKE JAZZ is at long last really becoming respectable. In fact, so much so that many of the nation's radio stations are now putting jazz into the same classification as "serious" or "classical" forms of music. The transition hasn't been completed yet but the signs are strong that things are happening. True, there is still a great deal of confusion as to the nature of jazz and how to program it, but the day is not far off when most radio stations will make extensive use of jazz library. In a way, this has an ironical twist since radio through the years has done very little to aid the cause of jazz and has in many instances done just the opposite. By allowing the song pluggers and publishers early in the game to take over much of the programming of music shows other than those what were strictly classical, the air became little more than an extension of the juke box in the local bar. This merely added to the confusion about jazz since many intelligent people began to believe that the products of Tin Pan Alley and the local disc jockey *were* jazz and they wanted no part of it. Because of this mixup jazz was—and still is, to a large extent—lumped in many minds with fan clubs, Joni James, and rock and roll. And speaking as one who has had some experience in the field, listeners were not the only ones suffering under that delusion. It also existed—and still does in many ways—in the radio station itself, stemming from the disc jockey right down to the record librarian. But the old order is slowly changing and more and more jazz is being placed in its rightful slot. Even the most hidebound of radio program directors are sneaking an occasional glance at the record review columns in such admittedly respectable journals as *The Saturday Review, Harpers.* and *The New Yorker*, and are beginning to wonder whether they ought to take a couple of those new LP's home from the library and give them a closer listen. Perhaps they might even allow a few of them to get on the air sandwiched between the Crew Chiefs and the inevitable Joni. For example, WQXR—long famed as the good music station of New York—has added a weekly show devoted to jazz. True, the show is only forty-five minutes long and is stuffy and pedantic, but clearly their heart is in the right place. Another chink in the wall occurred when NBC contracted to put many jazz remotes into the programming of the weekend show "Monitor," and as a result most of good reviews the show has received specifically mentioned the outstanding music they were airing. This has not gone unnoticed in the trade.

A few days ago, I talked to a record company owner who was frantically trying to line up some jazz artists for his label. He had made a pile in the pop market but in traveling around the country, and especially on some late night turnpike drives, he had come to the conclusion that the wise record company was one which could get into the jazz field while the getting was still good.

The only trouble is that he knows nothing about jazz and will no doubt get burned several times before he either drops the idea or hires someone competent to judge talent for him and who knows jazz itself. A company about to go into the serious music field would never dream of entrusting its catalog to the same personnel who worked in the hit-picking department on the pop side. Yet many of them do just that with their jazz catalog and then wonder why the sides they cut are ignored by jazz buffs. One thing they do, though, is to make the job of reviewing much rougher through sheer quantity of output. The days are gone when four or five singles a month was the normal output in the jazz catalog of the average label. And by singles, I mean 78's. Today they arrive in coveys by every mail and under all sorts of incredible labels. Many of these labels exist only for that single LP and are never heard from again, while others are usually found in the bird-call lists but are now taking the plunge into esoteric jazz. It grows wonderfuller and wonderfuller.

But like I said it makes for a slow track in the reviewing department. About all the reviewer can hope for is not to slight a really worthy disc because he didn't have the time to give it a proper chance on the turntable. Most LP's carry from 30 to 50 minutes of material these days and if a person has fifteen or twenty discs to review in a week it is easy to muff a good thing from time to time. Not long ago I had Billy Taylor, the highly literate jazz pianist, on a show of mine and we got on to the subject of record reviews. He said that almost every disc made today contains some material that could best be described as "fill," put on the record just to fill out the allotted LP time. By that he meant that an artist will intersperse with his best material a few items of lesser interest. He went on to say that he realizes many reviewers make a practice of listening to just a couple of cuts on any given disc when they are under the press of time to review a lot of stuff and that he lives in deathly fear that they will happen to hear only the so-called "fill" material when they are about to pass judgment on his recorded work. The quick answer to that one, of course, would be to never record secondary material, but such an answer would overlook good production techniques. A practiced and discerning recording artist of today looks upon an LP as an actual forty-minute performance and he expects to be listened to in that manner. So he sustains interest by varying his material skillfully so that he does not tire the listener by keeping him at an emotional peak. In the old days, a band would come into the studio and record four or five of their best things which could then be released at the discretion of the company, but always singly. This worked in favor of the artist in many ways since his material usually had a fresh sound only because the discs came through so widely spaced. A good case in point is the recent release by Columbia of a large collection of Benny Goodman masters under the title "BG-25," in reference to Goodman's 25th Anniversary on records. Most of the individual items had been released earlier as singles and had enjoyed tremendous commercial success, but when lumped together they have a sameness of sound and conception that is, at least to me, rather monotonous.

ABOUT MR. SHEPHERD

"This is Jean Shepherd—we have records . . ." Seven nights a week on WOR (New York) we hear those words, sometimes at 12:30 a.m. and sometimes at 1:00 a.m. when his program starts. And we hear them again at station breaks all night long until the cold gray dawn hour of 5:30, when the more enterprising souls are getting started on their daily grind and others of us are just getting home.

'Tweren't always thus. We first heard Jean on Saturady afternoons 'way last Summer, and all through the Fall except when some amateur sporting event known as football pushed him out of his accustomed time slot—which was from 3:00 to 6:00. But we heard enough.

Enough, that is, to realize that here was a man who talked about Jazz without sounding as though he were something apart from us common people who have not been touched by the magic wand of the licorice stick—those of us who believe that it is possible to enjoy jazz without having to "understand" it—without having to see the social significance of each note, each subtle phrasing. You know the kind of people we mean—the same kind that can enjoy Tschaikowsky or Bach or Kodaly or maybe even Copland without a Mus. D.

Anyhow, we finally decided that Jean was the right man to write about jazz for AUDIO readers, just as we thought that Edward Tatnall Canby was the right man to write about the classics when we heard him on the radio back in '47. And here is what Jean has to say about himself:

"I was spawned in Chicago at about the time Louis Armstrong joined King Oliver to make jazz history there. Bix Beiderbecke was playing club dates with Muggsy Spanier as a cornet duo. I have oscillated sympathetically to jazz ever since.

"Prior to World War II, while attending Indiana University, I jobbed around my native heath accompanied by a somewhat eroded bass fiddle which provided a means of attaining social success as well as tuition. After a three-year stint in the Signal Corps where I was kept in the lowly rank of corporal by jealous commanding officers, I was discharged by a grateful country and was free again to plague entertainment-loving radio listeners."

Since that time Shepherd has become a well known, if not yet well-beloved, radio raconteur of jazz, fine wines, sports cars, ash blondes, and pinochle. His "shows" have emanated from Chicago, WLW Cincinnati, KYW Philadelphia, and the Mutual Network. He has written for many technical as well as literary journals. A long-time audio buff, he is also a rabid amateur radio addict currently holding the call K2ORS. We're glad to have him aboard.

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LONDON AUDIO FAIR 1956

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Nostalgia and its effect on critical values will be the subject of one of these columns in the near future. In fact, there is so much to be said on the subject of nostalgia and what it does to usually logical and level-headed critics that I am almost afraid to tackle the problem in a magazine rather than in a set of morocco-bound volumes. It closes many an ear to the world around it.

Speaking of the world around us, a couple of unusually good discs can be heard reflecting a few contemporary sounds. And while just getting my feet wet, so to speak, in the columns of an otherwise august magazine, here are a few that come to mind this month:

The Jo Jones Special Vanguard VRS-8503

Some of the best Basie Rhythm sounds to be recorded in years. Jones, of course, is one of the really great drummers and was never better than on this fine LP. Basie himself appears on several cuts and once again demonstrates how rare a thing a good ensemble piano really is. He drives a group as though he had a bullwhip in his left hand and a .45 in the other.

Tangents in Jazz—Jimmy Guiffre **Capitol T-634**

A very unusual and highly commendable offering showing the latest work of a young and talented West Coast performer in the person of Guiffre. It is interesting to compare this material, all Guiffre originals, with his earlier work with the Herman bands. On this disc, according to the copious liner notes, Guiffre attempts to dispense with the usual usages of the rhythm section and instead use it as "punctuation" for the work and lines of the soloists. Don't presume that this technique does away with the beat: on the contrary it seems to be as strong as ever. By the way, Guiffre writes with rare humor and grace. This recording has been much listened to by contemporaries of Guiffre and already his influence can be heard in other groups. I recommend this disc without qualification both as to content and for technical excellence.

Thelonious Monk plays the Music of Duke Ellington **Riverside RLP 12-201**

Monk is one of the most controversial of present day musicians. He was one of the pioneers of the contemporary forms of music back in the early 1940's along with Gillespie and Parker, but his personal characteristics prevented his fame from spreading much beyond a small circle. Admittedly very influential among pianists of the present day, he has never been recorded too well. On this disc he appears with two excellent confreres in the persons of Kenny Clark (drums) and the admirable Oscar Pettiford (bass). He plays with a sort of acid poetic humor that always swings and is highly individual. If certain of his stylistic manners remind you of others, it is well to remember who came first. As we said, he has been very influential among younger artists. This is a most enjoyable recording and one worth owning. Technically good, too.

Rudy Braff Special Vanguard VRS-8504

Braff is a sort of throwback in today's world of highly trained technicians. He is a trumpet player of much drive and a kind of rough plaintiveness at times reminiscent of the best work of Bunny Berrigan, and who is famed among musicians for his inability to read music. On this disc he has the assistance of some exceptionally good men, particularly Vic Dickenson and Jo Jones. This recording is a good example of correct casting in that the musicians were carefully selected to give complete consistency.

This month we haven't tried to review everything currently available but have instead picked a few of the outstanding discs of more than usual interest. However, in future columns I intend to cover as much new material as space will permit, eliminating only those recordings that seem not acceptable to a serious jazz fan.

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PREAMPLIFIERS

(*from page 38*)

Tone Controls

The fixed equalizers which have been so far discussed are designed to compensate for known frequency curves built into the record. There are also many conditions affecting frequency response which are not known beforehand by the circuit designer. These include room acoustics (discussed in more detail in a later chapter), deficiencies in associated equipment which may unduly boost or attenuate portions of the frequency spectrum, changes in over-all volume which change our bass hearing sensitivity, and variations in program material caused by differences in microphoning, studio or hall acoustics, and so forth.

We cannot hope to compensate accurately for all such conditions, but flexible tone controls, intelligently designed to approximately correct for conditions typically encountered, can help a lot. These tone controls work on the same principle as the frequency discriminat-

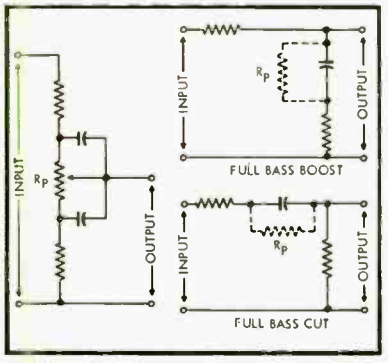


Fig. 6—6. Continuously variable bass tone control. Equivalent circuits for maximum boost and cut are shown, with significant elements at that point shown in heavy line.

ing voltage dividers discussed previously, with the difference that the rate of boost and cut, or the transition frequencies, or both, are controllable.

Figure 6—5 illustrates a treble tone control, and the equivalent circuits for maximum treble-boost (slider at the top of the potentiometer) and maximum treble-cut positions (slider at the bottom of the potentiometer). *Figure* 6—6 illustrates a bass tone control, also with equivalent circuits for maximum bass boost and maximum bass cut.

The effectiveness of a tone control is determined by the extent to which it affords accurate compensation for varying conditions. It has been the writer's experience that this object is best served by tone controls with either varying transition frequencies, or with transition frequencies which are some distance from the audio spectrum mid-point, say

(*Continued on page 67*)

BROCINER

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. . . as February AUDIO Magazine says:

"In a field which includes dozens of medium-powered amplifiers, there is always room for one more, particularly when its specifications and performance come up to the standards exhibited by the Brociner Mark 10. On the whole, the amplifier is designed along good engineering principles and does not rely on 'gimmicks' for its performance!"

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EDWARD TATNALL CANBY*

WALTZ TIME

Vienna Bonbons. (Waltzes, Polkas, Marches, Galops by Johann Jr. and Josef Strouss.) Vienna State Oper Orch., Paulik. **Vanguard VRS 459**

The waltz pie can be cut into a fascinating variety of slices via LP! This is a good title, for it suggests just what the record is, though perhaps not its full interest as an excellent performance of a raft of unfamiliar Strauss in the good old Strauss idiom. Only a handful of these will be already in your mind's ear—but most will soon memorize themselves, and to heck with fame and popularity! Wonderful stuff, played to perfection in Viennese style in Vienna.

The recording is in the hi-fi manner, close-up in a good resonance, with a hard edge, somewhat exaggerated triangles and the like, plenty of big, thumpy bass. Not too unsuitable for this sort of music, which should get away from the "concert hall" type of sound anyhow.

(Note: See also VRS 457, similar.)

A Portrait of the Waltz. Philharmonia Orch., Markevitch. **Angel 35**

This is no background disc. Rather, it requires a good deal of straight imaginative listening and is worth it too. The title, sober-minded, again is a good one. The idea is to offer a program of music embodying the widest range of penetration of the waltz idea itself—from the almost tearful seriousness of Liszt, to the rollicking trifles of Mozart's "Sleigh Ride;" from Stravinsky's raucously pleasant little waltz from his Second Suite to the sweetness of Berlioz and the "Valse Triste" of Sibelius, and a big noisy piece by Busoni.

The playing is intense, rather fast, not too often relaxed, wonderfully accurate, the contrasts from piece to piece skillfully planned and dramatically carried out. Sound is big, distant, in the now familiar Angel (EMI) manner, remarkably unlike the hi-fi Vanguard style of microphoning above. Surfaces gorgeous, quality the same.

Strauss Paraphrases, (Waltzes arranged for piano). Edith Farnadi, piano. **Westminster WN 18064**

Piano paraphrases of the waltz have always been popular—even into the jazz and cafe era. Many a big pianistic virtuoso has fixed himself up with scintillating showers of waltz-time, to show off his own prowess in a pleasing manner.

These are mainly of the ultra-flowery kind that go back to the influence of old Liszt, and they represent a technical challenge of the most appalling difficulty. They don't come over very well here. As played by Farnadi, the trills and ornaments and flourishes all but drown out the basic waltz music itself.

I can think of two reasons. One, perhaps, is acoustical: the recording is on the dry side where, it seems to me, it should have been as big and golden and liquid as the engineers could make it. These are old-fashioned transcriptions (arrangements), period pieces of another day, and they need an appropriate acoustical setting. The dryness brings out the detail work too prominently, showing up the musical seams in a harsh light.

Secondly, (or firstly if you will), Farnadi plays with an ultra-modern, dry technique that in itself accounts for a lot of the trouble. She plays all the notes and easily, but the music is drowned in them. Too much preoccupation with the flossy ornament—admittedly tough to play—and not nearly enough with the waltzes themselves.

This stuff can be played effectively, even today. But I don't feel that this disc does the job.

* *780 Greenwich St., New York 14, N. Y.*

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Each month, Mr. Canby will name one record as the "Problem of the Month." Listen to it, study it both as to music and as to recording quality. Then write a brief review on a postcard—no other entries will be considered—and send it to AUDIO, Dept. RR, P. O. Box 629, Mineola, N. Y. so that it arrives on or before April 2, 1956. Winners will be announced in the May issue, and the review chosen as first will be published, along with Mr. Canby's own review, in the same issue.

For this month's problem, Mr. Canby has selected:

Stravinsky: The Firebird (complete ballet) L'Orchestre de la Suisse Romande, Ansermet. **London LL-1272**

Buy it, borrow it, or just listen to it somewhere—then tell us what you think about it.

RULES

1. Decisions of the judges are final and no correspondence will be entered into regarding entries or choices of the judges.
2. Reviews of the selected record must be submitted on a government postcard. No others will be considered.
3. Only one entry will be considered from each contestant.
4. All entries are to become the property of Radio Magazines, Inc., and the one chosen as first will be published.
5. From the list of records reviewed by Mr. Canby in the issue in which the "problem record" is announced, the writer of the review chosen as first will be given three records of his choice; the writer of the review chosen as second will be given two records of his choice; the writer of the review chosen as third will be given one record of his choice.
6. Entries will be judged on the basis of both musical and technical accuracy. Neatness and form will not count, but the reviews must, in the opinion of the judges, be sufficiently legible to be read easily.

FOR THE CURIOUS BROWSER

Gilbert & Sullivan: Princess Ida. D'Oyly Carte Opera Co., New Symphony Orch., Godfrey. **London XLL 1200/1201 (2)**

Another D'Oyly Carte-London G & S! What more need be said?

A lot, come to think of it. "Princess Ida" is one of the rare operas, traditionally seldom heard—and like so many works of this sort, it also, traditionally, has some of the finest of all Gilbert and Sullivan music (and rhyme) in it. Why does this so often happen? There's no accounting for the opera stage.

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Indeed—and this is also the usual thing in such cases—this strikes me as a particularly intense and able performance by the famous D'Oyly Cartes, as though it were a relief to do this less-common opera, for a big change, instead of endless Mikados and Pirates and Pinafores, *ad inf.* The company seems to rise unanimously to the manifest superiorities of this music in many a spot and the results are splendid, no less.

The recording is splendid, too, big, fat, round, realistic, undistorted, with marvelous presence. Listen to the beginning of Act II, for example, with the chorus of females at the female academy of learning commanded by the redoubtable heroine, Princess Ida herself. It'll make you blush with sheer joy.

(Note that there's a single LP of highlights from the opera, for those who want 'em. Me, I wouldn't settle for less than the works.)

Steel Band Clash. (Music for steel band from Antigua, recorded on location). **Cook 1040**

Sequel to Cook's earlier "Brute Force" disc, that one named after one of the oil drum

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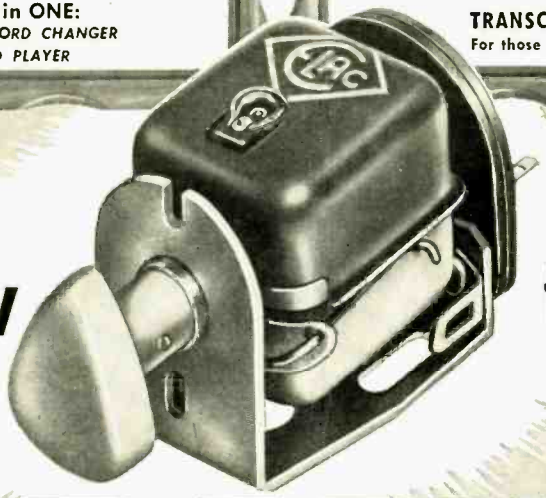


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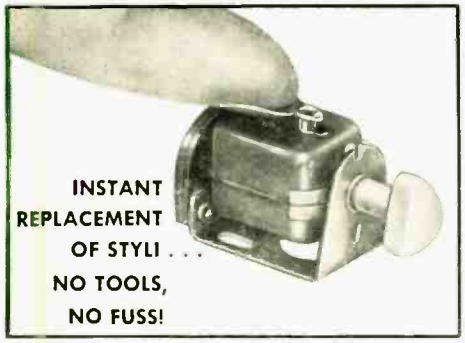
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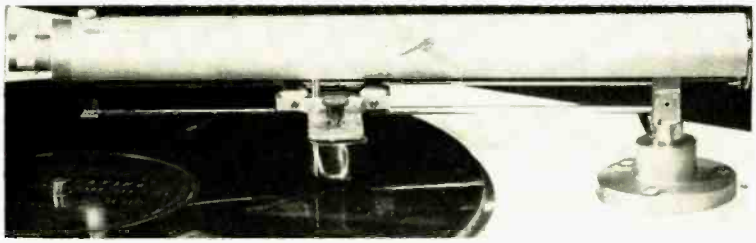
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bands, which also plays here. A fine hi-fi record and there's reasonable variety, too, even for outside ears. Cook's "15 kc crickets," under somebody's West Indies porch, are nearer 8000 cps, I'd say, but they do add an exotic touch of realism. Not as much singing in this as in the previous disc.

Note that the record is pressed by the new powdered vinyl Microfusion process. It sounds it—super hi-fi and with superb surfaces.

Folk Songs with the Trapp Family Singers. Dr. Franz Wasner, conductor.

Decca DL 9793

Here is the familiar Trapp format—groups of Austrian songs, instrumental yodels, spliced with a sonata or suite or two for recorders and harpsichord; this is the latest in a considerable series of records. It's memorable, though, first because it may be the Trapps' last disc. (according to hearsay, they are disbanding) and secondly because of its extraordinarily fine recording.

The small choir of voices is so ultra-realistic that you can virtually pick out each person and place him or her in the imaginative ensemble. Old friends will quickly spot an unfamiliar voice or two in the current group, and can almost name the others, one by one. The finest small-chorus recording I've heard, and the instrumental interludes are as good, in their way. The singing is up to the usual warm, modest but highly professional Trapp standards.

Monteverdi and Marenzio: Madrigals on texts from "Il Pastor Fido". The Golden Age Singers. **Westminster WLE 105 (1)**

Here are parallel madrigal settings of the same texts by two famous composers of the turn of the 16th century in Italy, Marenzio in the earlier style, Monteverdi already, in his highly original way, tending towards instrumental music and operatic drama. A most interesting comparison, with good notes to point up the listening.

The Golden Age group is British, conducted by its first soprano whose voice is one of those incredibly high boy-soprano instruments that one finds only in British lady singers. Indeed, this group sings at a higher pitch level than I would have imagined possible in this day of big, operatic vocal production. An extraordinary sound, almost vibrato-free. Only complaint: as is often the case in British singing, the Italian diction is something less than crisp.

Tuskegee Institute Choir. Spirituals. Conducted by W. L. Dawson.

Westminster WM 18080

Reviewing this disc is a matter of description; this choir is one of the best there is of its type, and the only question is—do you like this music?

The spirituals, in this form, are made into fancy choral arrangements with humming, solo voices, etc., effects not far from those of the well known Fred Waring ensembles. The performance is highly perfected, polished, balanced, the voices are superb as might be expected and the singing—given such fancy stuff—is quite spontaneously emphatic. So, if you like arranged spirituals, this is for you, but definitely.

If you prefer "authentic" negro folk music, in the simpler and less artful ways, then look elsewhere. This is hardly rough-hewn primitivism. Lead Belly probably wouldn't even recognize the tunes.

Old Possum's Book of Practical Cats. (Six poems by T. S. Eliot). Musical setting by Alan Rawshorne; Robert Donat, speaker, Philharmonia Orch., Rawshorne.

Angel 30002

This is the kind of title that makes one sit up, especially if one is a cat-lover. (Or maybe a cat-hater.) As one of the former, I sat up. I'd love to own me a real practical cat.

Well! . . . There's a lot more than a passel of cats here. First, a great, big, hi-fi overture, that'll titillate your monster speaker very

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nicely, cats or no cats. Nicely dry, expressive modern stuff, pleasant and appropriately unimportant for all its noise, with a faintly 1920's sound—but more of this in a moment.

Then, after a pause, starts Poem No. 1, about naming cats, three names for each one of 'em. Rhymed stuff, this, and against it (I say that advisedly) there is more music for the big orchestra. The two interfere a bit—Donat has to read pretty loud to be heard. No discreet fade-down background music here! Indeed, the music is oddly independent, in the background merely via distant-mike recording rather than by any intrinsic "backgroundness". The following five poems about cats continue the same—and I will not give their witty content away. But the music . . . .

It plays like a six-sided symphony while Donat reads of cats and cats and cats. And, at the end, it suddenly has occurred to me that this piece, with all its non-fading, non-background, accompanying music, has only one other counterpart in the field. That, unexpectedly, is a piece all of thirty-odd years old, right out of the Twenties. It, too, had sing-song rhymes read *against*, rather than *over* a snazzy, witty musical score. (That was before radio backgrounds.) In that piece, too, the speaker finds the going a bit tough against the constant musical competition, and in it, too, the listener rather wishes, after awhile, that he could hear each section apart. Verses without all that musical distraction—or music without the droning voice to gum it up!

The name? "Facade," by William Walton, with text by Edith Sitwell, and you'll find six different jolly LP versions of it in the catalogue. Four of them, note well, are without words.

By all means, if you like cats, try this practical little disc for size (10") on your cat-like instincts. And, if you are enterprising, get the companion London recording of "Facade," too, with the raucous-twenties verse spoken by Edith Sitwell herself and Peter Pears. (London LL 1133.) It's really a better work, cats or no cats.

Songs I Taught my Mother. Charlotte Rae; John Strauss and his Baroque Bearcats.
Vanguard VRS 9004

Maybe somebody's sides will split over these ditties. Mine are still in one piece. The allusion, in case your music appreciation is behind time, is to "Songs my Mother Taught Me", a singular song, if I remember rightly (i.e., not plural), by Dvorak, out of his Gypsy Songs, and a lovely item, too, which you would recognize in an instant if I hummed it to you.

Anyway, Miss Rae's "silly, sinful, & satiric" songs may be splittingly funny but they're splittingly unmusical to my ear, as well. She's not even the kind of imp or pixie (as the notes suggest) that I'd like to bring home to meet mother.

Try for yourself, if you like party entertainment records. I could be wrong—very wrong.

The Theory of Classical Greek Music. Fritz A. Kuttner, J. Murray Barbour; Robert Conant, harpsichord.
Musurgia Records (1A)

Don't be misled by that "harpsichord" listing into expecting music on this record. There is none, excepting for a couple of very ancient Greek hymns, played in their original scales. They sound dreadfully out of tune to our ears. The rest of the record is entirely scales and intervals—"example 29" intoned by a low-fi voice, followed by deliberately spaced harpsichord notes of various degrees of out-of-tunedness. This goes on for almost an hour.

What is it? A highly concentrated musicological study, for the first time with actual illustrations, of the tonal theories of the Greek writers. It is doubtless a very important work and I know that music libraries all over the country will want the record and its successors.

I am well aware that the old Greeks wrought mathematical miracles in their exact determinations of scales, tones, sound-vibrations. Modern theory of all sorts is really



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based on their work. I know, too, that the problems of scale pitch that were solved variously by these gentry are for the most part eternal problems of music itself, that still must be coped with in spite of our convenient (and out-of-tune) tempered scale.

But, alas, with the best will in the world I find this material not only audibly unendurable, beyond a band or two, but also just plain boring. And I can tell you why, very reasonably. Perhaps my reason has a bit to do with the difference—so often pointed out—between musicians and musicologists. The trouble with all of these subtly different sound illustrations is that *they aren't music.* And so my musical ear simply can't get hold of them in any intelligible way.

Now I have a pretty good ear, by repute. I am acutely aware of right and wrong pitch in all *music*—and especially in choral and string music that is often free of tempered pitch, and in older music that cannot even be performed with tempered pitch. I've sung it, have conducted it. But these non-musical pitch sounds, here, just leave my ear confused. Either they all sound alike (all subtly out of tune and unpleasant) or all unlike but equally unpleasant.

The reason is this. Music is *dynamic.* It is sound *in motion,* through time. Musical pitch means next to nothing unless it *moves*—is a part of a moving sound-pattern. Stop the sound, isolate single tones and forget the context—and they are no longer music nor do they make much sense. Pitch to my ear, to be musical, must move—always. And here are dozens and dozens of exact pitches and pitch relationships, virtually every one musically lifeless, completely *static.*

The simplest comparison I can think of is that of a tape recorder. The mind and the eye can analyze a stopped tape recording for its sound constituency. But the ear cannot. The very instant the tape stops it loses every vestige of sound-sense. That's what I mean by dynamic.

New York Foundling Hospital Benefit Concert. Solos, Mozart Choral Society, Boys' Choir. Impresario A-5137

This isn't for sale but if you want to help foundlings you may have one for a $5 donation. Speaking of pitch . . . this one features a more or less amateur concert (maybe *all*-amateur, for all I know) in which the sense of dynamic pitch—see above—is so excruciatingly twisted and warped that you'll howl with horror or laugh with glee! Really a quite amusing concert; everybody is so sincere and works so hard—and so out of tune. It's just that amateur events like this don't often get on LP records and the sensation is, to say the least, odd.

Add this to your Mme. Jenkins records (remember her?) and do the foundlings a good turn. Address: N. Y. Foundling Hosp., 175 E. 68th St. New York 21, N. Y., Rt. Rev. Msgr. J. Reilly.

Arlene Francis presents Music Appreciation for the Home. Camden CAL 256

Good homebody Arlene Francis (she's seen in almost every home) here gives two lengthy and mellifluous lectures upon—guess what—the Unfinished Symphony and the Nutcracker Suite, those old standbys of Great Music for the Beginner. There are a few—not very many—musical illustrations here and there, presumably (by the sound) from Camden reissues.

Oddly enough, Miss Francis' talks are quite well done up and interesting in their background subject material, though there isn't much room left for the music. (That might prove too heavy for long listening.) I don't know whether she wrote them herself, but I can only say that her dulcetly sweet-toned golden TV manner will make almost anybody quite sure that she has a good ghoster. It just sounds that way—overwhelmingly.

SCOUTS' ROUNDUP— ITEMS TO CHECK

Mozart: Cosi fan Tutte. Schwarzkopf, Merriman, Panerai, Simoneau, et al. Philharmonia Orch., Chorus, von Karajan. **Angel 3522C (3)**

I tried some of this, then turned it over to Scout #2 without comment. We agree. "The whole job is done lovingly and beautifully, and who's more beautiful than Schwarzkopf—but they're doing the wrong opera." She and Nan Merriman "sound like the female duets from 'Rosenkavalier'." Exactly.

Though Austrian, this is an Italian opera all over. These serious, modern-day Austrians simply do not get the brittle, gay, tongue-wagging spirit of it. Not really very good.

Mozart: Die Entfuehrung aus dem Serial (Abduction from the Seraglio), K. 384. Soloists, RIAS Symphony and Chorus, Fricsay. Decca DX 133 (2)

This rip-roaring mock-Turkish opera farce of Mozart's gets a "sweet" production, musically, here. "quite delicious"—which is not exactly my idea of its robustious qualities. But Scout #2 goes on to say that the spoken dialogue seems to be curtailed and he misses it strongly—too much music, without proper breaks and contrasts.

This is a very valid point. Mozart (as other opera composers who mix music and dialogue) calculated his pace and timing rather more carefully than some people imagine who think the dialogue is corny and dispensable. It isn't, really, even when you can't understand it. Necessary contrast.

The older London recording (XLLA-3) which I found absolutely delightful, has three records to this job's two. I suspect a part of the difference is in the removed dialogue, though I can't check at the moment. And by the way—this dialogue is awfully funny, in a Katzenjammer kids sort of style. I'd gladly pay the difference for it.

Tchaikowsky: Symphony #6 ("Pathétique"). Philh. Symphony of London, Rodzinski. Westminster WN 18048

I tried this first, then sent it on to Scout #1 to see what would happen. He feels that Rodzinski (ex-N. Y. Philharmonic) has long been one of the finest interpreters of the work; this version is generally like his older recording made in New York, now on Entré, though the first theme is slowed down, the finale louder.

He thinks the third movement, in both, is the finest concept of that music on records, and I agree with him. I found the scherzo style music extraordinarily interesting here. But the beginning of the work drags along in the strangest way, oddly bottled up in itself; there is a curious inability to get going, to "let go," which is doubly curious in the light of the emotional shambles that we so often hear in these passages.

The recorded sound bothers me. It is "hi-fi", of course, but in a rather special manner; the strings are very remote, the brass painfully near at hand, a very poor musical balance which we hope was not purposeful, for hi-er fi. It's decidedly possible that the odd musical effect of the opening pages—for strings—is entirely the fault of the engineering department; for it is when the brass finally appears, triumphant, that this recording really gets going.

Janáček: Concertino; Mladi. Phila. Woodwind Quintet, Rud. Firkusny, pf., Leon Lester, bass clar. Columbia ML 4995

I tossed this one to Scout #1 because he is gone on Janáček, who was a Czech composer who lived a long life and did much intense writing, quite modern in his old age, up to his death in 1928.

"Incredibly fresh, daring", ". . . white-hot intensity . . . luxurious, folkish modalities . . . stunningly recorded". I seem to have hit the mark! He loves it. I think you'll find Janáček a mild and "folkish" modern, quite easy to take; I wasn't that enthusiastic last time I heard him, but then, I have a lot of music on my mind. Scout #1 suggests a look-see-listen to Westminster's more "biting" Concertino, with the Baryilli group, while you're at it.

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NEW LITERATURE

• **Electro-Voice, Inc.,** Buchanan Mich., is publishing a new "Guide to High-Fidelity Loudspeaker Systems." It gives details about integrated 2-, 3-, and 4-way speaker systems, and acoustically-designed furniture-styled enclosures to suit the individual budget and esthetic taste. Also included is information about Electro-Voice do-it-yourself hi-fi enclosure kits. Of particular importance to music lovers is a section which tells how to choose a speaker system for fullest enjoyment of hi-fi music reproduction. Your request for a copy must include twenty-five cents ($.25) to cover handling and postage. Specify that you want Catalog No. 117. **M-1**

• **Terminal Radio Corp.,** 85 Cortlandt St., New York 7, N. Y., offers a storehouse of worthwhile information for the music lover, hobbyist and professional audio engineer in its "1956 High Fidelity Guide," a 132-page catalog of audio equipment. The booklet illustrates and describes Terminal's complete selection of hi-fi phono equipment, tuners, amplifiers, speakers, cabinets and tape recorders. Also included are microphones and public-address equipment. Consumer net prices are given for all items. A free copy will be mailed on written request. **M-2**

• **Cabinart,** 99 N. 11th St., Brooklyn 11, N. Y., in what is possibly the most complete catalog of hi-fi furniture ever published, lists and illustrates the company's entire 1956 line of equipment cabinets, cabinet kits, speaker enclosures and enclosure kits, multi-unit speaker systems, and furniture hardware and accessories for the sound enthusiast. New products for 1956 include thirteen cabinet and speaker-enclosure kits, all in birch- or white-pine veneered plywood. Ten of these are matching and modular, and are designed as a wall-storage-cabinet series. Cabinart offers the series as a build-it-yourself home entertainment center. Cabinet measurements and construction plans are shown throughout the 34-page 2-color catalog. Copy will be mailed free on request. **M-3**

• **University Loudspeakers, Inc.,** 80 S. Kensico Ave., White Plains, N. Y., now has available an informative and interesting brochure describing the new do-it-yourself kits for high-fidelity speaker enclosures embracing University's exclusive Decor-Coustic design. The booklet illustrates the features of University's new "Kwikits," easy-to-put-together kits of cornerless-corner enclosures which incorporate the best features of horn loading, phase inversion, and direct radiation. Also included is the utility model, in unfinished fir, of the "Classic" deluxe 3-way speaker system. A copy of the brochure may be obtained without charge by directing your request to Dept. LA8 at the address shown above. **M-4**

• **Tube Division, Radio Corporation of America,** Harrison, N. J., has just brought out a completely-revised edition of its "Interchangeability Directory of Industrial-Type Electron Tubes." This 16-page booklet lists 2000 type designations of 26 different manufacturers arranged in alphabetical-numerical sequence and shows the RCA direct replacement type or the RCA similar type, whichever is available. Included in the listings are power tubes, rectifiers, phototubes, camera tubes, and receiving-type tubes for industry and communications. The directory is priced at twenty cents ($0.20) per copy and may be obtained from RCA tube distributors or by writing to Commercial Engineering Department in care of the address shown above. **M-5**

• **Minnesota Mining and Manufacturing Co.,** 900 Fauquier St., St. Paul 6, Minn. has just published Bulletin No. 31 of the popular "Sound Talk" series covering the effect of coating thickness on the frequency response of magnetic tape. The three-page paper, illustrated by four charts, is intended for broadcast engineers, electronics specialists, and amateur technicians interested in magnetic recording. In the technical discussion, the effects of bias and audio recording currents on high- and low-frequency response on tapes with coatings of various depths are outlined, with particular reference to specific "Scotch" brand tapes. The method of determining optimum conditions is given, and effects of variance from these conditions are shown. The bulletin is available on request from the company. **M-6**



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NEW PRODUCTS

• Dyna High-Power Output Transformer. Guaranteed to have a frequency response of 6 to 60,000 cps within ±1 db, the Model A-430 is the first in a series of Dyna high-fidelity output transformers which utilize new design principles on which patents are pending. The A-430 matches Type 6550 or 6CA7/EL-34 tubes in circuit configurations furnishing from 50 to 100 watts. It is recommended for use in building Williamson-type amplifiers with 50-watt output using either of these tube



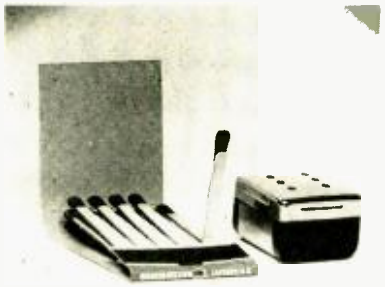
types. Undistorted power-handling capacity is 50 watts from 20 to 20,000 cps, and 100 watts from 30 to 15,000 cps. The transformer has excellent square-wave transmission at all audio frequencies, and its phase characteristics permit substantial feedback without inducing amplifier instability. Complete data on the Dynaco A-430 and circuitry for converting Williamson-type amplifiers to high power are available on request from Dyna Company, 5142 Master St., Philadelphia 31, Penn. **M-9**

• Miratwin Magnetic Turnover Cartridge. Consisting of two completely independent and non-reacting movements mounted back-to-back in a turnover mount, the new Miratwin cartridge is the latest component in the extensive line of hi-fi gear distributed in the U. S. by Audiogersh Corporation, 23 Park Place, New York 7, N. Y. Frequency response of the Miratwin is from 30 to 18,500 cps within ±2 db. Recommended stylus pressure is 6 to 8 grams. Exceptionally high output of approximately 50 mv at a stylus velocity of



10 cm/sec. at 1000 cps results in remarkably high signal-to-noise ratio. External magnetic pull has been eliminated to such a degree that the difference in stylus pressure with ferrous and non-ferrous turntables is virtually unmeasureable. Styli may be replaced instantly without the use of tools. Hum factor is inconsequential. Available with either dual-sapphire or diamond and sapphire styli, the Miratwin cartridge is designed for mounting in any standard tone arm. Catalog sheet will be mailed upon request. **M-10**

• Tiny Speaker-Microphone. "Mini-Mike" is a low-cost miniature dynamic speaker-microphone which can be mounted in the housing of dictating machines, portable



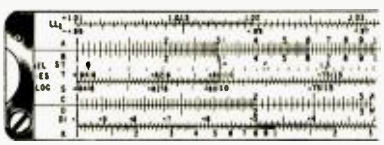
transceivers, and other electronic devices requiring transmitting-receiving units. It weighs only 1 1/3 ounces and is housed in a case made of steel and plastic. Dimensions are 1×1×¾ ins. Available as an accessory is a miniature transformer for matching the Mini-Mike to grid circuits. Sensitivity of the microphone with transformer is 52 db below 1 volt/dyne/sq. cm. As a speaker the unit will deliver 120 db with power input of 10 mw. Nominal impedance is 10 ohms. Further information will be furnished on request by Telex, Inc., Telex Park, St. Paul 1, Minn. **M-11**

• Capps Hot-Stylus Unit. Quality of disc masters for microgroove records is greatly improved over that obtained with cold-stylus cutting when cutting is done with a stylus heated by the new Capps hot-stylus adapter unit, models of which are available for all standard disc recorders and cutting lathes. The unit consists of a small lightweight stylus terminal block



which fastens to the cutting head of the recorder, and a control panel. The terminal block features a unique quick-disconnect feature for ease in changing styli. The control panel includes stylus-heat control, pilot lamp, on-off switch, and a meter for precise heater-current indication. The unit operates from a standard 117-volt 60-cycle a.c. line. Capps and Company, Inc., 20 Addison Place, Valley Stream, N. Y. **M-12**

• Eye-Saving Slide Rule. Design engineers and college students will welcome this new slide rule recently introduced by Pickett & Eckel, Inc., 1109 S. Fremont Ave., Alhambra, Calif. Scales are tinted in green-yellow to coincide with the optimum sight point of the spectrum, thus cutting



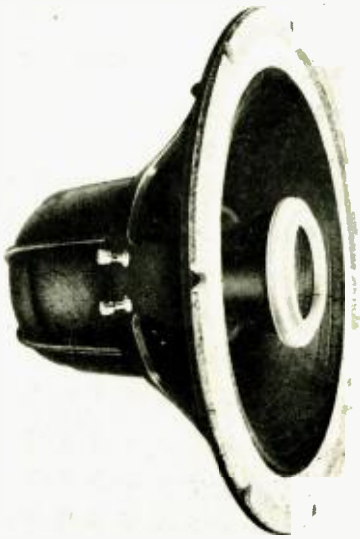
eyestrain, blurring, and errors in reading calibrations. Non-corrosive, non-rusting metal frame construction eliminates warping, swelling, and binding. The rule is available in 6- and 10-in. Trig, Log-Log and standard models, or in models made to special order. Free catalog on request. **M-13**

• Knight Tuner-Amplifier. Aptly named the Uni-Fi, this new low-cost combination features unified design to achieve excellent hi-fi performance in compact form. It has a full set of controls and combines an FM-AM tuner, a magnetic preamp and a 10-watt power amplifier on a single chassis. Frequency response of the amplifier is 20 to 20,000 cps within ±0.5 db. FM tuner sensitivity is 8 microvolts for 30 db quieting. In addition to an input for



a record player, an auxiliary input is provided for use with a TV receiver or a tape recorder. Included among the controls are separate bass and treble adjustments, loudness control, and a three-position record compensator. The Uni-Fi is housed in an attractive cork-grained metal cabinet with brushed brass panel. Complete technical specifications will be supplied by Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. **M-14**

• Racon Pneumatic-Damped 15-Inch Speaker. A new principle in cone suspension which employs pneumatic damping to afford long excursion and unusually low resonant frequency, is incorporated in the new "Hi-C" speaker recently introduced by Racon Electric Co., Inc., 1261 Broadway, New York 1, N. Y. The unique suspension, for which patent has been applied, results in practically a "free-edge" cone having great flexibility without encountering mechanical restraints. A special cellular plastic material is used between the cone edge and the supporting



basket. This material is composed of millions of microscopic cells which are randomly interconnected so that the degree of damping due to stiffening of air within the cells depends upon the amplitude of cone motion. At large amplitudes, such as at resonance and at low frequencies, the damping action is maximum. Because the damping mechanism is self-contained and is not affected by enclosure characteristics, the Hi-C may be substituted for an existing speaker in one's present cabinet with corresponding improvement in audio performance. The Hi-C line is available at present in three 15-in. models, a woofer, a dual cone, and the triaxial Model 15-HTX which is illustrated. **M-15**

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Built-in metered operational adjustment. Output transformer with low leakage reactance and high flux-handling capability. New type-6CA7 output tubes are more efficient and distortion-free. Variable damping from separate 4, 8 and 16 ohm outputs. Oil input-filter capacitor, long-life telephone-quality electrolytic condensers, terminal-board construction. **$189.00**



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Self-powered. 7 Inputs. Input selector, loudness compensation, volume, bass, cutoff filter, treble, turnover, rolloff, and power on-off controls. Low and high-impedance outputs. 3 switched AC power outlets. Response ±1 db, 20-40,000 cps. 1% maximum intermodulation distortion at 15 volts output. 4 microvolts equivalent maximum open-circuit noise at first phono grid. **$162.00**

AUDAX Hi-Q7



'Chromatic'

Magnetic Pickup CARTRIDGE and ARM

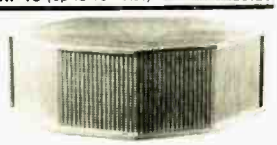
Widely admired for its natural sound, the Hi-Q7 features extremely high lateral and vertical compliance, 20-15,000 cps frequency response, an ingenious turnover arrangement with two individually replaceable styli in a single head, and superb overall listening quality. It comes with one near-infinite-compliance "Chromatic" diamond microgroove stylus and one micro or standard-groove sapphire stylus. **$47.70**

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Compass-pivoted tone arm — HF-12 (up to 12" disc) **19.20**
HF-16 (up to 16" disc) **25.20**

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Reproduces the range from 500 cycles to beyond the limit of audibility with unprecedented smoothness. Eliminates all coloration and distortion of the reproduced sound to a degree not possible with conventional electrodynamic "tweeters" of either the cone or the compression type. The ultimate in faithful sound reproduction when used with a woofer of comparable quality. **$184.00**

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Has separate AM and FM section, with independent tuning and level controls. Permits binaural reception or feeding different programs to separate points or recording one while listening to another. 'Automatic' FM tuning eliminates noise and hiss. Other FM features include: 0.5 μV sensitivity for 20 db quieting . . . 4-section tuning capacitor . . . cathode follower output. Other AM features include: 10 μV sensitivity for 10 db signal-to-noise ratio . . . image ratio better than 60 db . . . cathode follower output.

Complete with tubes **$189.95**



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Model 350-C console recorder *(illustrated)* **$1315.00**
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A wide-range, unidirectional microphone with a single moving element and featuring unusually high front-to-back discrimination. Frequency response is uniform from 50 to 13,000 cycles. The output impedance is 50 ohms with internal provision for easily adjusting to 150 or 250 ohms. Output is —57 db (Ref. 0 db = 1 mw/10 dynes/cm2).

The Model 666 is ideal for TV, radio, recording and other applications calling for high quality, and can be used with boom, floor and table stands, and other microphone mounts. Weighs only 11 ozs.

Complete with Stand Coupler and 20-ft., 2-conductor cable with Cannon UA-3-11 connector **$147.00**

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• Fairchild Power Amplifier. Although it is designed to deliver 75 watts continuously, the new Model 275 amplifier is conservatively rated at 65 watts with intermodulation less than 0.5 per cent. Extremely compact, the unit measures only $12\frac{1}{2} \times 7 \times 7$ ins. Its weight, however, is 32 lbs. even with the use of grain-oriented laminations in the massive output transformer. The 275 will not oscillate nor will it change over-all gain at any setting of the damping control, which is adjustable from 0.1 to 10. Taps are provided on the primary of the power transformer to permit full power output at any line voltage from 105 to 125. Also included are readily accessible adjustments for dynamic balance of the 6550 output tubes, bias adjustment, d.c. plate-current balance, and master gain control. Input signal required for full rated output is 0.8 volt rms. Output impedances are 4, 8, and 16 ohms. Styled by Raymond Loewy Associates, the 275 matches other Fairchild high-fidelity equipment. Fairchild Recording Equipment Company, 154th St. at 7th Ave., Whitestone, N. Y. **M-16**



• Stentorian Extended-Range 12-Inch Speaker. Utilizing a cambric cone as in other Stentorian speakers, the design of the new Model HF-1214 also incorporates six stabilizing discs of long-staple fibre which are impregnated into the front of the cone to improve mid-register response, particularly in the 1000-3000 cps range. Bass resonance is 39 cps and over-all frequency response is 25 to 14,000 cps. Power rating is 15 watts. Complete information will be supplied on request by Beam Instruments Corp., 350 Fifth Ave., New York 1, N. Y. **M-17**



• Tandberg Two-Speed Tape Recorder. Up to four hours of program material can be recorded on a standard 7-in. 1200-ft. reel of tape with the new Tandberg Model 2 tape recorder recently introduced into the U. S. by Reeves Equipment Company, 10 E. 52nd St., New York City, N. Y. Operating at speeds of $1\frac{7}{8}$ and $3\frac{3}{4}$ ips, the unit has frequency response curves within ±2 db from 60 to 4000 cps and from 60 to 7500 cps for the low and high speed, respectively. Wow is below 0.2 per cent. Noise level is down 50 db. Start, stop, forward, and rewind are selected by the proper positioning of a single "gear shift" knob. Recording lock guards against accidental erasure. Speed selection is afforded by a lever which may be adjusted while the recorder is operating when desired. The Tandberg 2 may also be used as a public-address system using its own built-in speaker, or an external speaker by means of an output jack. The Model 2-F is identical with the standard Model 2 except that it contains relays for electrically-operated remote control which is afforded by a plug-in foot pedal. Complete specifications are available on request. **M-18**





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Mark II

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50 watts at less than 1% IM for listening ease. 100 watts peak. Frequency response ±.5 db 6 cps to 60 kc. Full power available 20 cps to 20 kc within 1 db of 50 watts without exceeding 1% harmonic distortion over this range.

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Uses pre-assembled printed circuit board and simple physical arrangement. Only 9" x 9" x 6-5/8" high without sacrifice of performance, and can be assembled in 3 hours.

✓ **GREATEST VALUE**

$69.75 complete with all top quality components, included pre-wired printed circuit board, pre-punched chassis, protective cover, and detailed assembly instructions.

Complete specifications and circuitry on this new amplifier kit are available. See your Audio jobber or Electronic Parts Dealer, or write direct.

DYNA COMPANY

Dept. A 5142 Master St., Phila. 31, Pa.

CIRCLE 59A

• Electro-Voice 100-Watt Professional Amplifier. Intended primarily for high-fidelity wired-music and public-address systems, the new Electro-Voice Model A100 rack-mounting power amplifier offers advanced features and performance characteristics at a low cost which makes possible new economy in commercial installations. Frequency response is 20 to 50,000 cps within ±0.5 db and total harmonic distortion is under 0.5 per cent at rated output. Damping factor is adjustable from 0.1 to 10 to permit perfect coupling between the amplifier and the speaker system. Maximum power available is independent of the damping factor, remaining constant at all settings of the control. Additional controls include gain, balance, and power on-off. Complement of eight tubes includes four 6550's. Input of 1.25 volt rms is required for full output. Output impedances include 4, 8, and 16 ohms unbalanced, 70 volts balanced, with 600 ohms balanced available in chassis. The



A100 consists of two sections, each of which occupies seven inches of rack space. For full information write to Electro-Voice, Inc. Buchanan, Mich., requesting Specification Sheet No. 53240. **M-19**

• Pilot High-Fidelity Console Ensemble. The new Pilot Model PT-1040 is on AM-FM radio-phonograph which combines several of Pilot's hi-fi components in a



smartly-styled contemporary console cabinet. Included are the Model AF-825 FM-AM tuner, a new basic Williamson-type 14-watt amplifier, and an exclusive Pilot 3-way 4-speaker system which comprises a woofer, a mid-range speaker in a separate vented enclosure, and two tweeters. The record changer is the Garrard Model RC-80 equipped with a General Electric cartridge with diamond and sapphire styli. Frequency range of the PT-1040 is 50 to 16,000 cps. Controls include a 5-position equalizer, a 6-position function selector, and separate adjustments for treble and bass. Two built-in antennas are incorporated—a ferrite loop stick for AM and a folded dipole for FM. Dimensions are 28¾"h x 35¼"w x 16½"d. Concealed casters permit easy moving. Pilot Radio Corporation, 37-06 36th St., Long Island City 1, N. Y. **M-20**

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HIGH FIDELITY

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Please send me complete information about the **two new pre-wired and pre-mounted Collaro RC-54 units designed for ready use.

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CIRCLE 59B

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HF155 "Golden Gate"

FM-AM HI-FI TUNER

Here is quality FM (response ± 0.5 db, 20 to 20,000 cps) and improved AM, both most perfectly realized for finest reception in a unit only 4" high—at a very reasonable price. Outstanding features: Sensitivity, FM—3 microvolts for 20 db of quieting; AM—5 microvolts for 1.5 volts output; separate RF stage on FM and AM; discriminator with dual limiters; cathode follower with 2 outputs; AFC; flywheel tuning, FM di-pole antenna, etc.



NEW! HI-FI SOUND FOR TV!

Now, make your TV sound "come alive". Just plug the new RAULAND TV55 Tuner into the unit above and enjoy TV sound through your hi-fi system. Exclusive with RAULAND. See it—hear it soon.



1520 "Golden Crest"

20-WATT HI-FI AMPLIFIER

Designed for those who appreciate the finest in Hi-Fi reproduction—the very best for less. Features: Full 20 watts output; response, ± 0.5 db, 20 to 40,000 cps; 6 response curves (compensation for all record types); 5 inputs for complete hi-fi versatility; separate bass, treble controls; contour and volume controls; variable damping control; rumble filter, plus many other deluxe features. In compact cabinet, 4" high.



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RAULAND matching "Space-Saver" units are decorator-styled in smart charcoal black with marbleized gold finish, control panels in soft brushed brass. No cabinets required—fit beautifully anywhere. (Extension shafts available for behind-panel mount.)

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THAT NEW SPEED

This time it looks as if 16⅔ rpm were going to stick.

No use trotting out all the old laments about how we already have too many speeds and another one is unthinkable. We've been through *that* before. If 16 rpm has inherent commercial advantages, it'll be sold and that is that.

Columbia was as clever in this as it was in bringing out LP. "16" has been in the wind for a number of years, but until now it hasn't, so to speak, found anything to ride on. Though some optimists put out four-speed changers awhile back, the 16 records that finally then appeared were something less than a squeak, a new type of talking book. Interesting but hardly earth-shaking, and the quality really wasn't very good on them, with standard microgroove, on the batch I once tried (with an adapter of the "microverter" type, put on a 33 table).

The clever aspect of the present super small groove 16 is the hiway gambit. Who'd a'thunk it! Somebody with a pretty sharp mind, and it might just possibly have been Goldmark of CBS, who has his fingers in such things. Whoever it was, the idea was a honey, I guess. That is, it was something that would work out practically.

16 rpm in the home? That, my friends, is the biggest question. I don't give two mills if all the cars in the U. S. come with hiway hifi built-in, for 1957. Most cars already have radios and the hifi and record businesses have survived nicely, even though (natch) car radios are "hifi" too, nowadays. Perhaps 16 rpm will succeed in autos, perhaps not. I don't care.

But how about the home? Will we have another speed there?

I fear that we may, because of some fairly irresistible pressures. I haven't even heard the 16's yet, but I know a bit about them, and I opine roughly as follows.

Small records that play fabulously long. *Much lowered cost per minute of music.* Quality that is remarkably good—remarkably, that is, in view of the size and speed. Not really hifi in the most dignified sense; at best a sort of jiggered up hifi, a reasonably flat output achieved by a rather large amount of backstage tinkering with special equalizations and what-not. Nevertheless—quality that could easily come up to the sort of pioneer "hifi" that was so successful in Columbia's well known 360 table phonograph. That, too, was rigged and jiggered, not in the records but in the reproduction; but it did represent a legitimate improvement over the then-standard "home phonograph" sound, and Mr. & Mrs. Public recognized this quickly enough.

There you have the basic facts. The most important, I'm sure, is the potentially lowered cost of music on 16. That's the factor that always upsets ye olde apple carte. I don't at this point know the present prices, nor the potential mass-production prices in the hypothetical future—a very different matter. (Most new gadgets, like the ball point pen, start expensive, then work downwards as production grows.) But my suspicions are that if this 16-rpm record really caught on—in some form or another, in some field or another the price would drop out the bottom of the record market, and no quibblings about hifi either. Who quibbles, really, about that in the mass market? The function of hifi in the mass market is to give the admen something to talk about and the buyers something to dream about. Nobody, neither the one nor the other, ever gets to the fi itself.

But what field, what form? Well, there are already some new four-speed changers announced. Somebody thinks that the big, bulky, clumsy home changer is going to play these dainty little miniatures. Maybe at first—but I don't see that lasting permanently, the 45 notwithstanding. It would seem to me that the miniature-component revolution, now long overdue in the record playing field, might really and at last be set off by 16—for the record was the last necessarily "big" object left in the player mechanism. The turntable and its big record have determined the system's size.

Remember, we've been using miniature cartridges in absurdly big shells for years, the shells still left over from the pre-war period. We've been using big arms too, not only long but generally bulky, also pre-war style. The tiny 45 arm, in the original player, didn't catch. But that, of course, was with the "large" microgrooves. With 16-rpm grooves, far smaller, the big arm is going to be left in a pretty unstable spot. Just take a look at the hiway hifi arm, counterbalanced (like the Pickering arm) so it won't joggle. Ingenious!

(Who was it used to argue with me that the LP record was no good for dancing—the needle would skip; only the big 78 groove would do? Fiddlesticks! Given the right arm, the LP system is far less liable to external jarrings than the older type of heavyweight 78 arrangement. Elementary, my friends, and the new 16-rpm proves it. You could even dance in an express train with it—if you could stand up on the curves.)

Miniaturization of the record, the turntable and the arm assembly will complete the very practical revolution that has been in suspense ever since the small groove and the small cartridge came in together. It could be a vital part of the 16-rpm future.

But—biggest question of all—what will be *on* the new little records? That is the crux of the matter, in a way, for until the shrewd promoters figure out how to "angle" the 16, how to fill it up for best effect, they will get nowhere. Anything—

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from singing commercials to Bach cantatas—is possible.

I have at this point only one fundamental thought. The new discs are *too long*. Think that one over carefully before you jump on the 16 bandwagon.

Three Beethoven symphonies for a quarter! Well, maybe not that cheap, but who wants three Beethoven symphonies on one record? Three or four records, low-priced, and you've run right through Beethoven. And suppose you want the second movement of Symphony #5, somewhere in the submicroscopic middle of those silky, invisible supermicrogrooves. No hands here! Not of the sort you can see and feel easily.

Suppose it's Mozart. Nothing less than a gigantic potpourri of this and that and the other item would do, to fill up these giant timed discs. Whole programs at a gulp, and not chosen by you, to your taste, either.

Jazz? A whole jukebox full on one record, and you can't push one of those nice red plastic buttons and get the piece you want, either. Background? Ah, there's the real use for a lot of 16 rpms. Music for Everything, from cooking eggs to winding up the cat and putting out the alarm. Music all day from a handful of tiny discs.

So, to be serious, I think that the content, again, is the big problem on 16. Maybe you can run a very narrow band, shortplay, around the outside of the disc, but in the past this has never failed to make trouble. Logically or no, people always feel gypped when the space on the record isn't filled out. You can always spread the grooves, and that remedy, no doubt, will be widespread on 16, thereby undoing systematically a good part of the work that was done in cramming in so many grooves in such a small space. But with so much—so very much—space to cover, in terms of time, even this remedy, groove-spreading, isn't going to help much.

What happens if records are too cheap? What happens if you can get *too much* music for your money, on too little space? More than you want and, worse, a lot that maybe you don't want at all? That's to be seen, if and when 16-rpm invades the home.

IDEAS IN THE MAIL BAG

Week in and week out, I set aside a trickle of letters into a special file marked IDEAS. These are letters I've found particularly interesting or informative, or letters which have set off some chain reaction in me that is likely to spill over into print sooner or later. Generally I tend to answer these and then put them out of mind, or glance at them later just to remind myself of the subject matter. My hard-working subconscious gets around eventually to the points at issue and heaves the stuff back at me again when the time is ripe. But sometimes it's good to quote verbatim from a few of these epistles, as I've done in the past. This month I'm pulling out a few on which to comment at some length, with thanks to their respective authors.

Japan

An old friend, five years in Tokyo as an AP correspondent, is an ardent hi-fier of long standing and has recently written me a bill of particulars on the subject, dateline Tokyo. Just to emphasize his points, the other day, he flew in himself (for a promotion, I think) and said the whole thing all over again in person. Told me I'd better quick put something in my column

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Gentlemen:

This is a report on a number of tests we have run on the Racon 15-HTX, 15" tri-axial Loudspeaker and here is what we found:

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The final test we made was with a vacuum tube voltmeter and an Oscilloscope.

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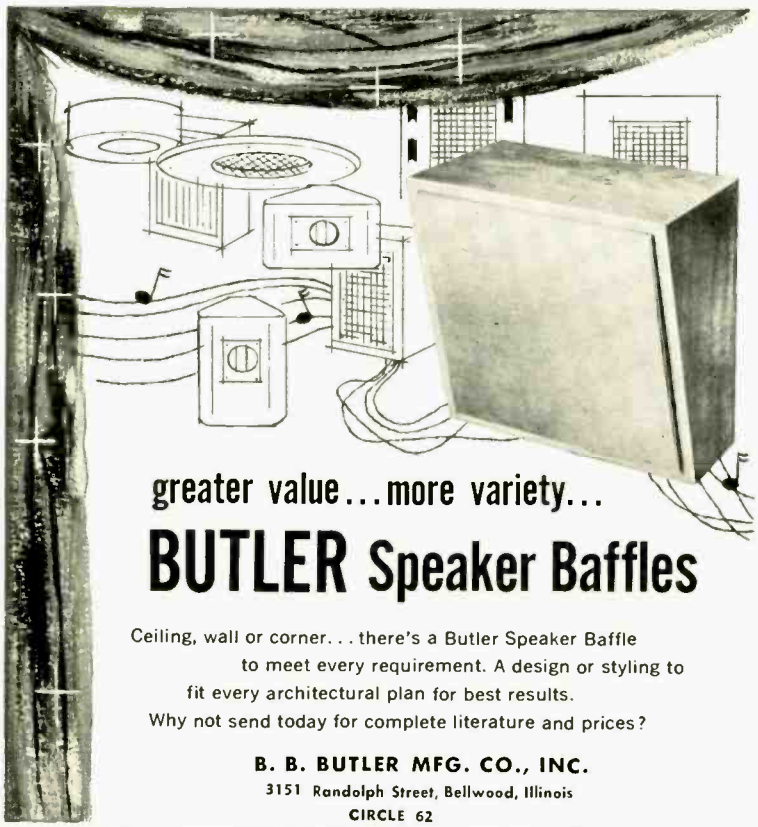
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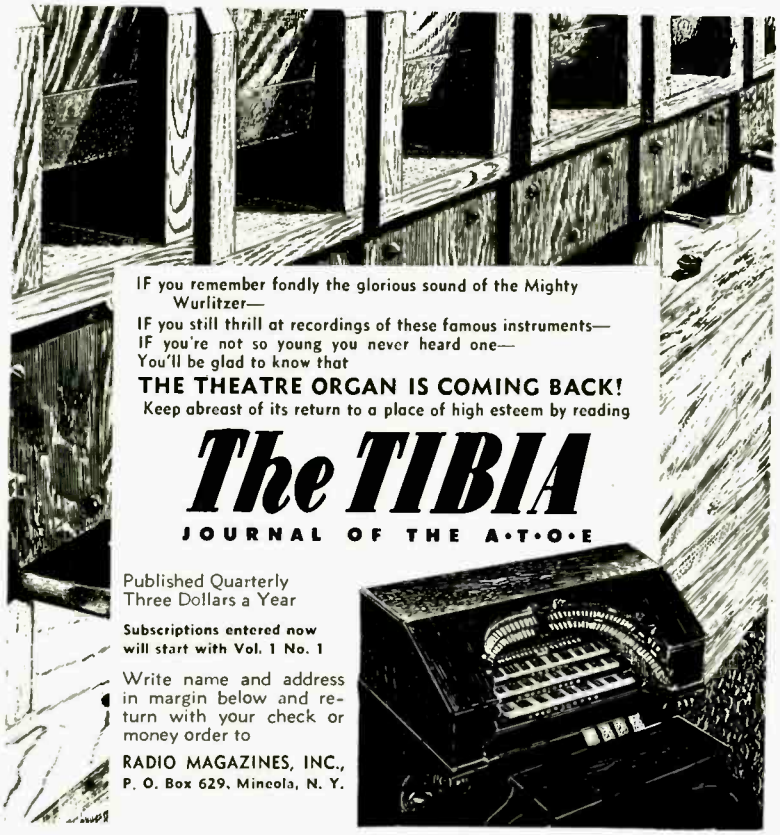


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about Japaness hi-fi and suggested maybe I'd like to call it "WATCH JAPAN."

Well, I'll pass on the basic information that Japan *is* moving in on hi-fi with the usual enterprise of that country's business and the usual extremely low production costs combined with remarkably high quality and plenty of designing ingenuity—and this gent expects there'll be some heavy invasion of the U. S. by Japanese hi-fi products before very long.

The Japanese, as you must know, are very skillful at *adaptation*. Let's not call it *imitation*. That word implies a slavish, non-intelligent horning-in on other people's ideas and products. It also implies a necessary inferiority in the imitation, for imitations are by definition unimaginative. The original product is the one which results from intelligent brain work. The imitation is bound to suffer.

But adaptation—yes. That implies an intelligent, calculated borrowing of basic ideas, concepts, even models, for a similar but not always identical product in terms of local industrial potentials. It may be as good as the original and often is an improvement. We've seen what the Japanese can do with such precision products as cameras and field glasses which they adapted mostly from German originals. (I have a marvelous binocular, sent over by this same correspondent some years ago.) Now it's going to be hi-fi, and though we may not like the borrowing of ideas, we're going to have to compete with it and admire it. Or tangle ourselves in a dismal welter of lawsuits and Congressional bills of exclusion.

"As you have probably seen . . . hi-fi has come to Japan," writes my friend, "and it is pretty good, too. A smart business man would start getting import rights. They are making some fine stuff now."

For instance, the Japanese have already launched a small speaker in the U. S. which is said to have outstanding characteristics. If I am right, it sells, ready-mounted in a special reflex enclosure, for around $22 here, which is unbelievably cheap in view of the U. S. competition it runs into. The speaker is said to compare very well with such standbys of the present market as the British Wharfedale itself, with cloth surround, and the American Permoflux.

But here's the joker. I gather that this sort of speaker sells in Tokyo for the equivalent of a $5 bill, more or less, and this to the general public. Take that.

"Japanese amplifiers are good but no bargain in the states," says my friend, "pickups are not bad either, but still no better than GE. Speakers are coming along, too, with some intriguing things like leather-suspended 20" woofers. . . . Heavy turntables are excellent with cast bronze platters and big G.I.-type motor and low rumble." The fellow is enthusiastic about this development, especially the bronze table which is heavy and a good flywheel.

"But the best buys are arms. They make some real honeys here. The various Gray models are imitated down to the last screwhead and so is the Pickering. . . . There are some good ones of a sort of combination Clarkstan-Livingston design that are also excellent. But the best one I've seen yet is a scaled-down 12-inch adaptation Gray 108B."

Remember, I'm merely quoting ideas, as a sample of what maybe a lot of U. S. hi-fi manufacturers are likely to be in for in the days to come. (This fellow brought one of these arms over to me and so maybe I'll have more to say about it later on a personal try basis.) I suspect Gray knows all about this arm already and I can only suggest that there are two sep-

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arate problems which are major ones in all such cases.

(1) Does the Japanese product really compare favorably to our own—are they up to us, or even ahead of us? Are we keeping our designing and ideas up to theirs?

(2) What can we do about the drastic production-cost difference, that favors the Japanese product even when import costs are added?

As to the first of these points, I suggest that righteous indignation on the part of our manufacturers will not get them very far, however justified. Keep in mind, as I say, that the Japanese genius is for inspired adaptation. Call it ruthless, lawless, unprincipled, if you will, but recognize its intelligence and skill. It would be folly to do otherwise. Legal measures no doubt can and will be taken in some cases, and with every reason. But just don't under-rate the Japanese ability.

As to the second, the unfavorable economic ratio that gives the Japanese a whopping basic advantage, I can similarly limit myself to the same sort of suggestion. Don't let the low Japanese production costs blind us to good work on their part—if and when. Good work is good work, at any price.

The ideal situation, of course, would be a government protection that would put Japanese goods on our markets at competitive prices, design for design. But who's to determine what is fairly competitive and what is sheer exclusion of foreign trade? And who's to say what effect this might have on our diplomatic situation in that ultra-ultra-touchy Eastern area?

Truly, it's one world with a vengeance, these days. Not even a pickup arm can be imported without rocking the international boat.

* * * * *

I'll add a few more items on the present picture in Japan. "Japanese AM radio continues first rate—flat to 10,000 cps, which makes listening very easy. . . . Japanese studio engineers, using Altecs and Telefunkens, can show our radio people a thing or two. The Japanese AM broadcast of Gieseking and Szigeti here was the finest radio sound I've heard, FM or no. I use a germanium diode tuner (the J. W. Miller circuit) and it is terrific. Cost $12."

"The whole country is music-mad—all kinds of music, right up to mambo. University kids sell their blood literally (its for transfusions) to buy concert tickets when big-time foreign artists come here. The US could do well to send more people like the Symphony of the Air here. It would help balance the necessary but unpleasant defense installations.

"I'm still making up hi-fi sets . . . some 22 by now. For the upper stratum I use Japanese turntables and arms, a much superior setup. . . . I've more or less stabilized on the (XXXX) amplifier, the (XXXX) for folks who want changers, and (XXXX) cartridges. . . ." (I am censoring the brand names since this is no export competition department). But I would like to note that this gent now has a habit of making up special speaker cabinets that take advantage of the incredible price bargains open to Americans. Twelve-ply Phillipine mahogany is his standard building material!

His own over-size Klipsch "short horn" (in consultation with Klipsch himself, I gather, and so with permission) is framed in gorgeous wood with genuine six-coat Japanese lacquer, hand-applied over many weeks. Cost about as much as a good coat of wax in the U. S. The local cabinetmakers do a fantastic job of carefully solid workmanship on these boxes, following my friend's designs though often they don't know what they're building. Tolerances, needless to say, may be made far more exacting than for mass-production woodwork, yet the cost is just plain negligible.

And that brings up a final and rather important point. I've had a number of letters recently, both from Japan and from Europe, asking for specifications on various of the special speaker enclosures now available—RJ, Karlson, Klipsch, etc.—so that the writers could have special models built by local cabinet makers. Some had already gone ahead—and built up quite sizeable businesses among Americans and others interested.

Now most of these operations are at cost, non-profit, and strictly hobby stuff, on a relatively small scale. Nevertheless, I have in every case answered these letters seriously, suggesting that these people were, knowingly or not, infringing on somebody else's rights, unless they had express permission. Copying a patented design.

My Japanese friend, for example, has been putting together some very nice RJ cabinets. Twelve-ply Philippine Mahogany, with bracing and screw-work of a sort quite impossible in any commercial U. S. model. He even worked out a corner triangle RJ, being an ingenious laddie himself, and this one is a lacquered job, at that. How did he do it? Simply, and quite honestly, by taking the measurements from a commercial RJ cabinet, and you may be sure plenty of other people have done the same, in all parts of the world and at home.

Licensing of such an operation is not really practical. The return would be too slight even if there were enough "business." There aren't published plans available either for most of these special enclosures for a similar reason; not worth the small business. As I understand it, my friend, who is an honest man, did apply to the U. S. promoters and offered payment, but got only a negative reply for his efforts.

And yet, just the same, I feel strongly that as a matter of ethics none of us should build a patented device, speaker enclosure or what-have-you, without at least doing our best to extend the courtesy of recognition to the people who did the work in the first place and who own the idea.

I've suggested to my friend—and this will put him fairly on his honor—that much better than a payment of petty cash would be a token of appreciation to the inventor, out of politeness. A gift. My suggestion was simple in his case—an RJ cabinet. If he takes my advice, he'll ship to R or to J, one of these days, the most luxurious RJ cabinet either inventor could dream of, 12-ply mahogany and lacquered to a fare-thee-well.

I'm sure any inventor would feel happily recompensed by such an offering—worth far more in the U. S. than it will cost in Japan. And I suggest that all those who are at present "borrowing" patented designs, including the group that wrote me from Germany (special model inexpensively turned out by a local German cabinetmaker, for peanuts), consult their best consciences as to what sort of a gift might best express their appreciation of an inventor's work well done—for them. It's only fair.

* * * * *

Speaking of "borrowing" (I'll get this in under the Japan heading, while I'm talking) there have been numerous deliberate commercial steals of equipment recently in our very own sweet country, and not for fun either. RJ was the victim awhile back, with models "borrowed" straight down

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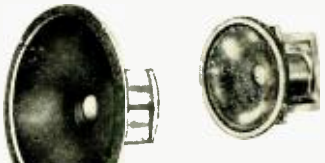
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The Nation *(B. H. Haggin)*

"... achieves the seemingly impossible; a real and clearly defined bass in a cabinet only 14 by 11⅜ by 25 inches in size."

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"... reproduced the full range of bass, even the pedal tones of the organ, cleanly and spectacularly ... shook the concrete reenforced floors of the Hotel New Yorker..."

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THE AUDIO LEAGUE REPORT
(Oct., '55) Pleasantville, N. Y.

"Speaker systems that will develop much less than 30% distortion at 30 cycles are few and far between. Our standard reference speaker system,* the best we've ever seen, has about 5% distortion at 30 cycles."
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the line, since suppressed, or modified beyond the immediate reach of the law. But the crassest example I know of recently made use of this column to promote a "steal." The speaker cabinet in question was advertised as the "CR-15 compressed air acoustical suspenion speaker system" in one ad and "Villchur-type" was added in another, though it was in no way authorized or licensed by the inventor, Mr. Villchur, who sent me the ads himself. But the "borrowers" went further than this, which was at least straightforward if unethical. . . . *Read Canby's review of the system in the latest issue of* AUDIO *and drive out to Pomona to hear it,* was the blithe suggestion.

That was not quite straightforward. For, you see, I wrote my article about the Villchur AR-1, acoustical suspension speaker system, the original. I have not heard the CR-15 and do not intend to hear it, or any other unauthorized version of the basic invention.

ABOUT MUSIC

(from page 8)

theory—*Messiah* was composed in twenty-four days.

Ignorance, poor performances, and lack of faith in Handel's dramatic abilities have conspired against these scores for many years. Handel's biographers skip over huge areas of his most important creative periods (all the standard books mention only *en passant* such a powerful opera, for example, as *Sosarme*); when an unusual score is performed it is generally assigned not to the top singers of the day (as it was done in Handel's time), but to artists who have little sympathy and less talent for Handelian style; and finally, one too often forgets that an original musical mind can overcome and even put to its service the most stilted and conventional artistic formulas.

The LP era has seen steps taken to fill the gap, but with generally disappointing results. The few adequate performances in the catalogue are still of the "until a better version comes along" variety. 1956, however, promises to be a good year for Handelians. In January, Sir Thomas Beecham signed a contract with Angel Records. To inaugurate his new affiliation, he will direct the first complete recording of the oratorio *Solomon* with soloists, chorus and the Royal Philharmonic Orchestra. Two major Handel works were released this year by London ffrr on the L'Oiseau-Lyre label: *Semele* (OL 50098/100) and *Sosarme* (OL 50091/3). Technically, these new recordings are head and shoulders above comparable works already in the catalogue—and that includes the L'Oiseau-Lyre catalogue as well. The French clothes-closet acoustics that mars older O-L releases is replaced here with the delightful resonance and clarity one associates with the best London products. The soloists are mostly competent and at times superlative, e.g., Alfred Deller's "instrumental" approach to his part, and Jennifer Vyvyan's easeful handling of both the lyric and coloratura aspects of her role in *Semele.* Conductor Anthony Lewis does not whip up too much excitement but the New Symphony Orchestra (in *Semele*) and the Saint Cecilia Orchestra (in *Sosarme*) play well in spite of him. Also, the Italian pronunciation by this all-British cast is a bit on the self-conscious side; there is no Mediterranean fire here. Nevertheless this is a significant release and a vote of thanks is due London Records for its superior contribution to Handelian art.



*Curve plotted from stock amplifier using TRIAD HSM-189 output transformer, as listed in General Catalog.

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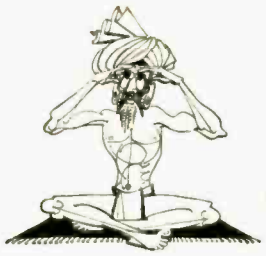
(*from page 2*)

of your claims. If you do, you are entitled to appeal to the Board of Appeals, composed of nine Examiners-In-Chief plus the Commissioner and his Assistants. If this fails and you are still of the same mind, you can go before the Court of Customs and Patent Appeals or take other legal action.

It is pretty obvious that the examiners who do the day-to-day work of examining applications and either allowing or rejecting claims are the backbone of the Patent Office and the most important individual to most inventors. It is usually on his sole responsibility that your invention does or doesn't result in a patent and that your allowed claims give you or don't give you the protection you want and ought to have. While he can be wrong—and knows it—and will read your attorney's arguments with an open mind and no personal axe to grind, his is usually the final word, since few cases are appealed. And since few companies or individuals would spend a great deal of time and money inventing if they did not feel that they could get protection, the examiner's actions have a very direct and profound influence on the entire advance of technology. This is as much true for the largest companies as for the most insignificant individual inventor, for the examiner is as impartial and careful with one as with the other.

Obviously, an examiner gains a tremendous education in doing his job. Not only does he examine applications for patents on the newest developments, but he must also spend a good deal of time reading the literature and referring to other patents to be sure he does not allow a claim which should have been rejected. Of all the engineers and scientists in the country, a patent examiner is probably one of the most knowledgeable. Though the Patent Office doesn't like it said because this is a way of losing valuable examiners, many of them have stepped into advanced positions in industry, a move made possible by their encyclopedic knowledge of their subjects gained on the job. And the job especially appeals to men who don't like "routine" or tasks which keep their noses to the same grindstone day after day. An examiner finds a new problem with every application he picks up, one on which he must use his powers of analysis and reasoning; there is nothing automatic or routine about looking into another man's mind and making a fair, learned, and complete answer to his arguments.

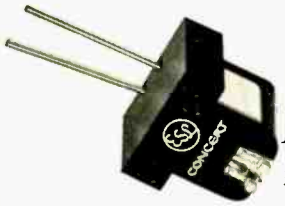
An examiner requires, of course, a great deal more skill than any new employee can be expected to have. While there is no training school or course in the Office for the people who are employed as examiners, training tasks are assigned to new people which over a period of years train them to do the very responsible work independently. As a matter of fact, recent surveys have shown that the average examiner does not reach his full value until after eight years of experience in the Office. A new man or woman turns out only about 31 per cent as much work as an experienced examiner in terms of applications finally disposed of.



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AT HOME WITH AUDIO

(*from page 26*)

Twenty-four hours later I applied a thin coat of pure white shellac which was diluted 50 per cent with denatured alcohol. The surface was then sanded again, very lightly, with a #0000 paper, and a second coat of shellac applied. Twenty-four hours after that, one coat of Super Valspar varnish was applied, allowing 48 hours before sanding this coat down. A second coat of varnish was then applied, and another 48 hours later the surface was rubbed down with a combination of crude oil and powdered pumice. This, plus plenty of elbow grease, took the high glossy sheen off the varnish and gave the cabinet a smooth, satin finish. Two coats of wax were then rubbed in and the job was done. The same finishing formula was used on the strips of molding.

. . . This is where the tape ran out. Ends above the reader's communication, continues below our rounding-out commentary.

The Compatible Speakers

This version of the Bozak B-305 three-way system now consists of two B-199A woofers and the B-209 midrange unit. As the entire Bozak system is power rated at 30 watts, response of 35 to 16,000 cps with 6 db-per-octave crossovers at 800 and 2,500 cps, the substitution of the Altec-Lansing tweeter II-808/802-B driver, with the same low crossover point and the same power rating, is happily and for all practical purposes, workably identical with the Bozak system and its own array of tweeters, as catalogued. (*Fig.* 11). Wherefore, a group of music lovers and a technician or two were called in to help balance the system. To do so, they went off instruments pretty much and landed the hi-fi craft by ear-beam, to the strains of some fresh, brand-new recordings.

Particularly useful was the Fritz Reiner-Chicago Symphony version, on RCA-Victor's LM-1807, of the dynamics-filled *Ein Heldenleben*, in which Richard Strauss's towering, fruity tuttis (all the T's crossed, all the I's dotted) and solo tootlings have been given the full-range recording technique they deserve (something like 30 to 18,000 cps, according to the text on the record sleeve). Passages were played over and over again as heads were bent forward, ears pointed at their keenest to judge the sound fairly, particularly the highs which unmistakably needed pegging downwards. To what degree, was determined in fairly short order. In the best judgment of the group the most satisfactory listening level, *for that room*, was established at point 30 on the dial of the 15-ohm Clarostat CIT-pad, along an arc calibrated from 0 to 100. This, we are told, proved to be attenua-

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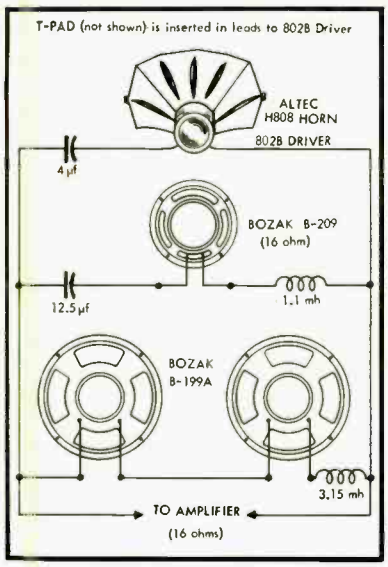


Fig. 11. Schematic of three-way speaker system shows wire-up and values of components. It is also plan of physical placement of speakers within and atop of infinite baffle.

tion enough for this unison of speaker components to sing out both decorously and fulsomely, as mood willed and ear could accommodate—without disturbing the neighbors.

Hi-Fi Disciples Are Made

The impact of hi-fi might be nowhere so dramatic in effect, to begin with, as in listening to the faithfully rendered repercussions of percussion instruments. The fledgling hi-fier's interest is pegged at the percussion level. It is such a new experience. He is real gone on concentrations of such instruments: their boom and bang, the zing and the ping. He is the sonic harrier, so to speak, who learns to track down the same sounds, familiar but dispersed, modified and secondary, along entirely new musical terrains. Anyway, play the music — any kind—and it will be appreciated and loved for as many different reasons, and at as many levels of comprehension as there are people. In these early stages of hi-fi-ness, the system components are (justifiably) bought by fame-of-name mostly, letting their fitness in a given home environment be what it may. Later, having lived at home with audio and feeling more at home with hi-fi the gentler, profounder and perhaps more enduringly satisfying joys of symphony and quartet, concerto and sonata, oratorio and opera—flower slowly to genuine appreciation. And with that gladsome attainment may come the need for reappraisal of the hi-fi baggage of our first voyagings to the moon. As in the speaker situation described above, change in equipment, if then advisable and affordable, equips us for the greater adventures. Your dollars, spent more purposefully, then get you equipment engineered, designed and made to serve you well, with close to professional standards of precision, *in terms of your own place.* At this point it behooves us to report that the subject hi-fier of this month's chapter of at home with Audio is that pleased with his new speaker system of best fit for him that he has declared a budget of a few hundred dollars to buy more recordings of the classics including the moderns. Seems to us to be a giant step, this, with more than seven-times-seven league boots — from novice to devout, music-loving, seasoned hi-fi enthusiast.

It isn't exactly a wild talent, this one of discovering and loving music through a sort of home-study course in *sound*-appreciation, after having played the game of hi-fi sound aces wild, so to speak. What you then get of greatest value is a sizable piece of peace of mind, all conditions being equal. For you have reached the point of pleasantest returns: through knob and switch and jack you are able to commune at will with the works of the masters written down in the universal language of musical notation. The hi-fi controls are a means to your happy hi-fi endings which, of course (because we have plastic and impressionable minds, and hi-fi innovations get through to them) are forever beyond reach.

Or, as our headpiece would have it, *there's no hi-finality,* exclamation point.

PREAMPLIFIERS

(*from page 49*)

500 cps for the bass and 3,000 cps for the treble. In any case the way *not* to judge the "effectiveness" of a tone control circuit is to twist the knobs all the way in each direction and to see how unnaturally screechy and boomy the sound can be made. Tone controls which really work where they are needed, without unduly affecting the mid-range, usually have a less dramatic but far more musical effect, even in their extreme positions.

Loudness Control

We have seen, in discussing the Fletcher-Munson effect, that as the overall volume of sound is decreased our bass hearing sensitivity is reduced significantly. In listening at volume levels lower than that of the original music, then, the original tonal balance will be

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changed, and we should be able to introduce compensatory bass boost. Some people like to do this themselves, with the bass control; others like to have it done automatically, by a bass boost circuit tied to the volume control. In the latter case the volume control becomes a "loudness" control.

Control Units

Control units performing the functions of preamplification and control of bass, treble, volume, and record equalization are available commercially as separate units, and also in combination with the tuner, the power amplifier, or even the record player. There is really no inherent advantage of one scheme over another, except for operating convenience, if the design is properly executed. Placing the control elements near power transformers or phonograph motors increases the hum problem, but this does not imply that the more difficult solution will be any less satisfactory.

HOW LOUD IS SILENCE

(*from page 19*)

results obtained by laboratory experimentation in the field of auditory thresholds, and the ultimate limitation by Brownian motion.

Conclusion

The most favorable circumstances encountered in acoustical research laboratories up to the present time have not been sufficient to justify an assumption that the acuity of the human ear will attain the region of Brownian movement of the air. It must be borne in mind that Curves (C) and (G) presented for thresholds in minimum audible fields are those of trained observers, sensitively alert to the faintest sounds. Conceivably, some human being possessed of phenomenal hearing may be able to approach these hearing limits. But as this approach is made, it is well to remember that biological disturbances such as the pulsing of the blood in the skin of the auditory canal, or the coursing of air through the respiratory organs will contribute to the masking of external noise. Furthermore, presence of the Brownian motion of the ear itself would, in the final analysis, mask any motion of the air. Under these circumstances, it would appear that man will never be aware of the turbulence of the air about him, if the motivating force is the Brownian motion.

Bibliography

Stevens and Davis, *Hearing*, p. 110. Wiley, 1938.



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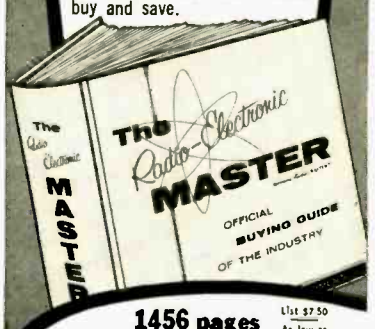
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TRANSFORMER DESIGN

(*from page 30*)

(b) Keeping interprimary inductance very low by using a bifilar winding technique usually increases the effective primary capacitance. Higher capacitance in turn reduces the available power at low distortion.

The performance is then quite analogous to that at low frequencies where

$$VA = P_o - jP_o/d \qquad (45)$$

Analysis indicates, in a similar way, that at high frequencies volt-amperes VA_h must be furnished (at high power levels) in accordance with

$$VA_h = P_o + jP_o/d_h \qquad (60)$$

where $d_h = X_C/R_L$. (61)

and X_O = effective primary capacitive reactance

We can now recall that capacitance, being basically a measure of length, has a proportionality

$$C : V^{1/3} : W^{1/3}, \qquad (62)$$

where V is volume and W the weight.

If $K = 2$, then W is reduced by $2^{3/2} = 2.83$ and the capacitance of the smaller transformer is reduced by a factor $2^{1/2} = 1.41$, almost a half octave.

(c) The combination of greater bandwidth, lower interprimary leakage and lower capacitance can now contribute substantially to the design of an economical high performance B_1 amplifier.

Limits of K

For over a decade it has been known that a low generator impedance obtained with negative feedback would improve the performance of a mediocre output transformer. But, unfortunately, feedback amplifiers using such transformers perform poorly at *high* power levels.

The writer has used small values of K (in the range of 1.4–1.6) and maintained adequate high-level primary inductance for low distortion in conjunction with grain-oriented laminations, and employed winding techniques common to the traditional output transformer.

Tests on stable zero-source-resistance (attained by controlled positive feedback) amplifiers with output transformers designed in accordance with the procedures outlined in this article confirm the advantages stated herein.

AUDIO CLINIC

(*from page 32*)

second instance is equal to that produced by the single speaker in the first instance, the more limited cone travel permits the voice coil of each speaker to operate in a more linear portion of its magnetic circuit, reducing the harmonic and sub-harmonic distortion in each speaker. Frequency response will be the same with one or two speakers.

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Industry People...

PHILADELPHIA SOUNDORAMA. **Russ Tinkham,** sales manager for Ampex Corporation, **Avery Fisher,** president of Fisher Radio Corporation, and **Karl Kramer,** technical executive for Jensen Manufacturing Company, headed up contingents



View of the technical staff and equipment in the control box at the Philadelphia Academy of Music.

representing their respective companies at an impressive demonstration of high-fidelity recording in Philadelphia's Academy of Music on the night of February 13. The Philadelphia Orchestra, conducted by **Eugene Ormandy** was recorded both normally and stereophonically on Ampex tape recorders, then played back immediately through eight Fisher 50-watt amplifiers each of which was feeding a Jensen Imperial speaker system.

Approbation of the capacity audience was ecstatic. The demonstration-concert was produced by **M. Robert Rogers,** president of Washington's good-music station WGMS, and general technical supervision was in the hands of **Thomas Tate,** widely-known symphonic broadcast engineer. Other audio authorities who attended in official capacities were **Robert Paulson** and **Melvin Sprinkle** of Ampex, and **George Maerkle, James Parks** and **Frank Malley** who represented Fisher. Present as a technical consultant was **William Chambers,** the well-known Philadelphia lawyer who has built a national reputation for himself as an authority on both of his hobbies—high fidelity and photography. Although present at the Academy during the set-up period in the afternoon, when speakers were placed and levels adjusted, he had to miss the concert itself in order to preside at a meeting of the Philadelphia camera club of which he is president.

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MUST SELL—PILOT AF-860 tuner, Gray 108-C arm, Bozak 207A, Fairchild 65-watt amplifier, all brand new, best offer. Box CM-1, AUDIO.

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WANTED: D-Spec disc recording head—the old field-coil cutter with long rubber damping line. R. K. Morrison, 933 Colusa Ave., Berkeley, Calif.

WANTED: BACK COPIES OF "RADIO" MAGAZINE. R. Scott, Powerhouse Road, North Hills, Manhasset, N. Y.

REL PRECEDENT Tuner, $260, f.o.b. Mt. Hermon. Virgil Foster, 17 Pine Ave., Mt. Hermon, California.

COLLECTORS! 71 Edison disc records, early pops, light classics. $1 each, $60 for all. Send 10¢ for list. Box CM-2, AUDIO.

FOR SALE: 3 Western Electric 555 drivers, $30 each; 2 Simplex 35-mm motion picture projector heads, rear shutter, double bearing intermittents, excellent condition, $175 pair. John G. Bitel, 282 Ringwood Drive, Wantage, L.I., N. Y. SUnset 1-8979.

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Angeles High Fidelity Show as a propitious occasion for previewing the new Craftsmen Model CT-2 AM-FM tuner and the companion Model CT-3 amplifier . . . **Cap Kierulff** has been appointed president and general manager of Kierulff Electronics, Inc., and Kierulff Sound Corporation, Los Angeles. The entire electronics industry tenders its best wishes to a great guy in his new job.

J. Philip Worth has joined Gray Research & Development Co., Inc., as plant manager . . . **Joseph F. Hards,** president of the Magnetic Recording Industry Association, announces the appointment of **Mark Mooney, Jr.,** to the post of executive secretary . . . **Sanford L. Cahn** has been named to the same position with the Institute of High Fidelity Manufacturers . . . **Arnold K. Weber,** who has been associated with RCA and its predecessor companies since 1918, has been appointed director of manufacturing . . . The entire audio industry shares the sorrow of Carduner Sales Corporation over the passing of **Eddie Kleeman,** associate and cherished friend for more than twenty years.

B. L. MacPherson has been chosen as Western divisional sales manager for Reeves Soundcraft Corp. Increased use of Soundcraft magnetic products by the motion picture industry has prompted the firm to open a new West Coast office at 338 N. LaBrea, Los Angeles, according to **Frank B. Rogers, Jr.,** executive vice-president . . . Election of **Walter W. Slocum** as vice-president in charge of operations of Daystrom, Inc., announced by **Thomas Roy Jones,** president . . . **John P. Jacks,** formerly catalog sales manager of Voice and Vision, Inc., Chicago, has joined the sales staff of Magnetic Recorders Company, Hollywood . . . **Vice Admiral Murrey L. Royar, USN (ret.),** has been elected a director of National Co., Inc.

Avery Fisher of Fisher Radio Corp. has been unanimously elected Chairman of the Board of Directors of the Institute of High Fidelity Manufacturers for the 1956 term. A charter member of IHFM, Mr. Fisher has been active in all Institute matters. Among the many problems which will be solved by the Institute during the coming year are those of show sponsorship and the dissemination of high-fidelity information to the general public . . . **Harold F. Cook** has just been appointed to the newly created post of director of advertising and market research of Tung-Sol Electric, Inc., and managers of three new sections have been named as his assistants. They are: **Robert M. Andrews,** manager of advertising and sales promotion for electronic products; **Edward G. Hazeltine,** manager of advertising and sales promotion for automotive products; and **Gerald A. Morgan,** manager of market research.

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How REK-O-KUT Maintains Quality Standards in Rondine* TURNTABLES

Subject: Induction Motors

The motor is probably the most important part of the turntable. Yet, it is amazing how little information is generally furnished about its performance. Examine most specifications, and the only reference you may find is "4-pole induction".

It is true that "4-pole induction" is not to be ignored. It is, at least, evidence of the use of a type superior to the 2-pole variety. But, there is more to a motor's performance than type — especially in this application.

The motor provides the necessary motion to the record. But, it is also a common source of vibration, and a notorious cause of rumble, wow and flutter. Unless the motor is built to provide a smooth, steady flow of power it is virtually useless for high quality turntables.

That is why Rek-O-Kut devotes so much attention to the motors used in the Rondine and Rondine Jr. turntables. To begin with, every motor delivered to Rek-O-Kut is subjected to a rigid inspection. The motors are first placed on 'run-in' racks, where they are permitted to run for at least 12 hours. This serves as an effective check against over-heating, seizing and general break down failure. If operating properly, this warm up brings the motor to maximum efficiency — ready for speed measurements and other tests.

Bearing tolerances are carefully measured. Motors that do not come up to Rek-O-Kut standards are disassembled and rebuilt. Rotors are then tested for dynamic balance and corrective measures applied where necessary.

The next important step is to determine each motor's rpm speed. This figure is then used to calculate the exact diameter for each step on the pulley so that the pulley-idler ratios will give the correct rpm for each record speed.

The grinding of the speed-steps on the pulley is one of the most fascinating procedures in the entire process. In order to assure absolute concentricity of pulley-to-motor shaft, the lamitex material of which the pulley is made is first drilled and press-fitted over the motor shaft. The motor is then connected and run so that the shaft and pulley material revolve as one piece. With the motor thus acting as its own lathe, and the shaft as its own center, the lamitex is ground down to the predetermined diameters. In this way, the pulley is absolutely centered and balanced on the shaft.

After re-checking, the motor is installed in a Rondine or Rondine Jr. turntable. Shock mounting and acoustical filtering are employed to isolate the motor from the chassis. The turntable is then turned on, and after the warm-up period (about 15 minutes) stroboscopically checked for speed. After speed corrections are made, no further adjustments are necessary except, possibly, after long periods of use.

The induction motor is only a small part of the story. Rek-O-Kut quality control extends into every detail of turntable production. At other times we shall discuss the hysteresis motor — the idler and other parts, which influence performance. All to help you visualize and understand that quality is a full time job.

These are the **REK-O-KUT** Rondine* **TURNTABLES:**

3-Speed

Rondine Deluxe with hysteresis motor	**$129.95**
Rondine with 4-pole induction motor	**79.95**

2-Speed

Rondine Jr. Model L-34 (33⅓ and 45 rpm)	**49.95**
Rondine Jr. Model L-37 (33⅓ and 78 rpm)	**49.95**

(4-pole Induction Motors)

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TWO BASIC SERIES. Standard Model 80 Series replaces most ceramic or crystal cartridges. Model 80M Series provides replacement for *all* magnetic pickups with no adjustments or circuit modifications required.

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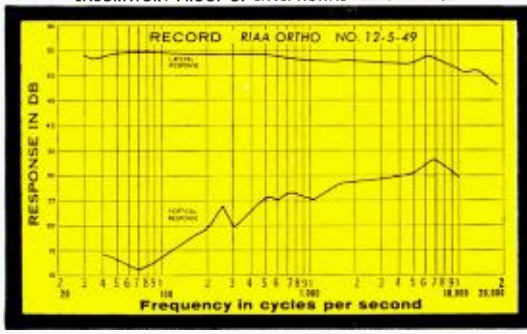


E-V 80 Series Turnover Pickup Provides Extra Benefits. Two independent generating cartridges in one! Full power for stylus in use . . . no distortion or resonance from unused stylus.

TYPE	STANDARD E-V MODEL	MAGNETIC REPLACEMENT	STYLUS	NET	RECORD SPEED
Single Play	81S	81SM	0.3M Sapphire	$9.60	16 RPM Extra Fine Groove
Single Play	81D	81DM	0.3M Diamond	23.10	16 RPM Extra Fine Groove
Single Play	82S	82SM	3M Sapphire	9.60	78 RPM
Single Play	82D	82DM	3M Diamond	23.10	78 RPM
Single Play	84S	84SM	1M Sapphire	9.60	*45,33,16 Talking Book
Single Play	84D	84DM	1M Diamond	23.10	*45,33,16 Talking Book
Turnover	85TD	85TDM	0.3M Diamond 1M Diamond	48.00	16 RPM Extra Fine Groove *45,33,16 Talking Book
Turnover	86TD	86TDM	1M Diamond 3M Diamond	48.00	*45,33,16 Talking Book 78 RPM
Turnover	86T	86TM	1M Diamond 3M Sapphire	34.50	*45,33,16 Talking Book 78 RPM

NOTE: The numeral "4" appearing in the model number indicates microgroove stylus; the numeral "2" denotes 78 rpm tip; the numeral "1" denotes 0.3 mil extra fine groove tip. "D" denotes one or more diamond styli; "S" stands for sapphire stylus. *Also 78 rpm Microgroove.

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