AUDIO

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SPECIAL: FORUM ON MICROPHONES & HEADPHONES

The ew tape cording standards

Multiple speaker connections can fool you!

Plus stereo hi-fi equipment and record reviews, Audio Clinic, Tape Guide

SCOTT

Scott 388 120-watt FET AM/FM stereo receiver outperforms finest separate tuners and amplifiers

The new 120-Watt solid-state 388 is specifically designed for the accomplished audiophile who demands the best . . . and then some. Every feature . . . every performance extra that you'd expect to find in the finest separate tuners and amplifiers is included in the 388 . . . along with many features that you won't find anywhere else. The 388's enormous power output, suitable for the most demanding applications, is complemented by Scott's exclusive 3-Field Effect Transistor front end*, which approaches the maximum theoretical limit of sensitivity for FM multiplex reception. The 388 offers virtually flawless reception of both local and distant AM, too . . . thanks to Scott Wide-Range design and wide/narrow switching for AM bandwidth.

* Patents pending

388 specifications: Music power (at 0.8% harmonic distortion), 120 Watts @ 4 Ohms load; Frequency response, 15-30,000 Hz ±1 dB; Power bandwidth, 20-20,000 Hz; Cross modulation rejection, 90 dB; Usable sensitivity, 1.7 μV; Selectivity, 40 dB; Tuner stereo separation, 40 dB; Capture ratio, 2.5 dB; Signal/noise ratio, 65 dB. Price, $529.95.

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AUDIO

July, 1967 Vol. 51, No. 7

Successor to RADIO, Est. 1917

AUDIO Articles

AUDIO Reviews

AUDIO Profiles

AUDIO in General

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COMING IN AUGUST

1. **Audio's big annual directory of hi-fi stereo component equipment.**

   - At-a-glance specifications of latest models.
   - Arranged for easy comparison of features.
   - An authoritative, year-long buying guide.

2. **Forum on Headphones and Microphones, Part II,** concludes the roundtable discussion with manufacturers.

3. **The New NAB Tape Standards, Part II,** continues to examine professional broadcasting guidelines for magnetic tape reproducing and recording.

4. **Fundamental FM,** a new column by Leonard Feldman, will make its debut in this issue, joining Audioclinic, Tape Guide, and other monthly departments.

ABOUT THE COVER

One of the "Decorate with Sound" exhibits sponsored by the Institute of High Fidelity is pictured here, illustrating that yon need not compromise sight to enjoy the best in sound. In truth, component hi-fi stereo equipment provides greater decorating flexibility than "package" equipment. For further proof of this, turn to page 35.

AUDIO CLINIC

Joseph Giovanelli

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

Electrolytic Capacitors

Q. I have always understood that electrolytic capacitors were poison in audio signal circuits because their AC characteristics were not uniform in both directions. For crossover network we were advised to use two electrolytics back-to-back.

Now, our newest and most expensive solid-state power amplifiers use large-capacitance electrolytics to couple the output stage to the speakers!

Is this an improvement over an output transformer? Ralph E. Day, South Hadley, Massachusetts.

A. You are quite right when you say that an electrolytic capacitor has different conductivity characteristics as a.c. passes through it. In one direction the electrolytic capacitor acts a a capacitor should. When the direction of the current reverses so that the negative terminal of the capacitor is connected to the positive terminal of the supply circuit, the unit will act as though it were a conductor. Further, electrolytic capacitors, even when they are polarized correctly, will conduct a small amount of current.

You have asked a question which is doubtless of interest and concern to many readers. To answer it, let me explain it this way. Let us assume that we have a transistor collector circuit which has 10 volts on it. The coupling capacitor from the collector goes to the base of the next transistor in the normal manner. The base is very near ground potential, so we shall say that the voltage impressed across the capacitor is, indeed, equal to the collector voltage on the transistor. This is the same situation which would occur if we were discussing the plate circuit of a tube.

Now we introduce a signal into the collector of our driver stage. This is an a.c. signal. We wish to pass this signal to the next stage. The a.c. voltage is one volt. This means that the collector voltage will vary under signal conditions from 9 volts to 11 volts.

The only question remaining is whether or not this negates the objections to electrolytic capacitors pointed out in your question and at the beginning of my answer. First, we said that when the *voltage* changed direction, we were in trouble as far as the electrolytic capacitor was concerned. That is true. However, under the conditions we have described for a typical collector circuit, the voltage across the capacitor has not changed direction; it has only changed in magnitude according to the a.c. appearing in the collector circuit. This means that the charge on the capacitor will vary in accordance with the a.c. and the signal is thereby transferred to the base of the next stage. If it were possible for the a.c. voltage to exceed the collector voltage, the polarity of the voltage across the capacitor would reverse. Then we would be in real trouble.

However, this cannot happen. The transistor would be destroyed first. It would be impossible to drive a circuit that hard, although it is possible to destroy a transistor. Think of a vacuum tube. Can you ever feed so much signal into it that you make the plate voltage go negative? The answer is a solid "no." How can you make the voltage go below that put out by the power supply?

I point out, too, that electrolytic capacitors are leaky even when proper polarity is observed. However, the leakage is much too low to be objectionable in the low-impedance circuits encountered in solid-state equipment. What is a leakage resistance of I megohm going to mean in a base circuit whose resistance is 100 ohms? The leakage effects of the capacitor will be completely masked.

When coupling the output stage of a transistor amplifier to a speaker, there is voltage present on the output terminal of the driver-d.c. voltage, that is. We don't want this d.c. to enter the speaker. We only want the a.c. signal component to do so. An electrolytic capacitor is the logical choice for this is the easiest way in which to get a large amount of capacitance into a small package. Fortunately the a.c. signal component impressed on the d.c. voltage of the output stage of our amplifier does not exceed the d.c. voltage or we would have the same kind of difficulty spoken of earlier.

When electrolytic capacitors are used in crossover networks, we have an entirely different situation. There is no d.c. against which the signal can work. Therefore, we do use two capacitors back-to-back so that as one becomes conductive, the other one acts like a capacitor and keeps the current in bounds and also keeps a uniform characteristic from one half of the cycle to the other. This is quite a different case from the events we have been discussing.

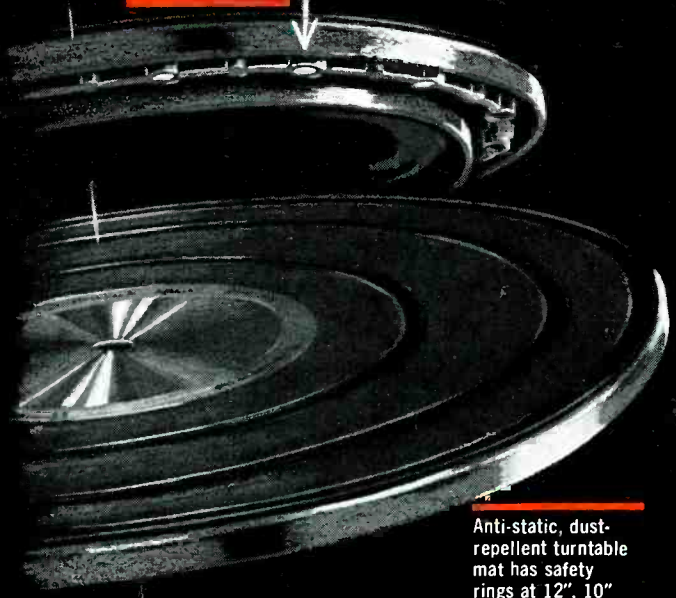
It is fortunate that electrolytic capacitors can serve in these solid-state devices because paper capacitors having the requisite capacitance values would be prohibitively large and would negate the miniaturization capabilities inherent in the transistor and its relatives. Æ

Mark of the leader...

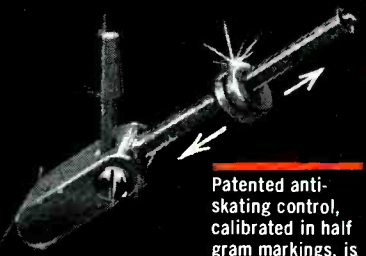
GARRARD'S LAB 80 MK II

The ultimate expression of over 50 years of Garrard leadership, this much-imitated but unequaled automatic transcription turntable contains many developments invented, perfected and brilliantly refined by the Garrard Laboratories, and now considered essential for the finest record reproduction.

Heavy, cast 12" anti-magnetic turntable is dynamically balanced with copper weights on underside.



Anti-static, dust-repellent turntable mat has safety rings at 12", 10" and 7" positions to protect stylus should automatic switch be activated without record on turntable.

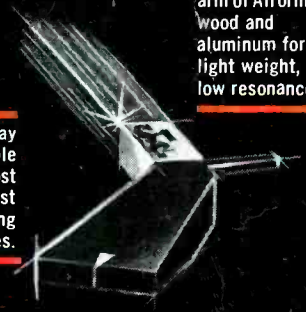


Patented anti-skating control, calibrated in half gram markings, is adjusted with springless, sliding weight.

Two interchangeable spindles: short spindle facilitates manual play; long, center-drop spindle handles eight records fully automatically.

Hydraulic cueing and pause control eliminates damage to records or stylus through manual handling.

Dynamically balanced, counter-weight-adjusted tone arm of Afrormosia wood and aluminum for light weight, low resonance.



Low mass cutaway shell compatible with the most advanced, lightest tracking cartridges.

Built-in stylus pressure gauge, calibrated in quarter gram intervals, has click-stops for precise, audible/visible settings.

Just two years ago, the stereo high fidelity world was introduced to the Lab 80, the first Automatic Transcription Turntable. It was instantly acclaimed because of the significant developments it contained. These imparted professional performance capabilities never before anticipated in automatic record playing units. Now, the Garrard Laboratories have refined and surpassed the original model with the Lab 80 Mark II, still priced at only $99.50, less base and cartridge. It is one of five new Garrard Automatic Turntables each of them the leader in its class.

For complimentary Comparator Guide, write Garrard, Dept. AG-1, Westbury, N.Y. 11590.

Fundamental AUDIO

Martin Leynard

BASIC AMPLIFICATION

As we mentioned last month, both microphones and loudspeakers are inefficient—microphones do not convert all of the sound energy striking them into electricity, nor do speakers convert all of the electrical energy they receive into sound. Feed the output of even the most efficient microphone into the most efficient of speakers, and their combined inefficiency will convert every roar of sound to reach the mike into a whispered output from the speaker.

A practical sound system, then, needs something that will beef up the microphone's feeble output until it's capable of driving even an inefficient speaker to high sound levels—in other words, an amplifier.

Amplifier circuits are the backbone of all electronics. In a high fidelity system, you'll find them not only in the component called an *amplifier* but in tape recorders, tuners and preamplifiers. Whether transistor or tube, all amplifier circuits operate on the same general principle: controlling the flow of a larger voltage or current so that its output waveform duplicates the waveform of an input signal, but on a much larger scale.

The British, in fact, call vacuum tubes "valves," for the grid of a tube, where the signal enters, acts as a valve controlling what otherwise would be a steady flow of current through the tube.

How tubes work

In a vacuum tube, the input signal is fed to a wire mesh *grid* which lies between a negatively charged pole, the *cathode* (which is busily emitting a hefty cloud of electrons), and a positive pole, the *anode* or *"plate"* (which, left to its own devices would attract virtually all the emitted electrons in a steady stream across the vacuum or inert gas that fills the tube). The grid is charged more negatively than the cathode, and so tends to repel the negatively-charged electrons and deflect them in their rush towards the plate.

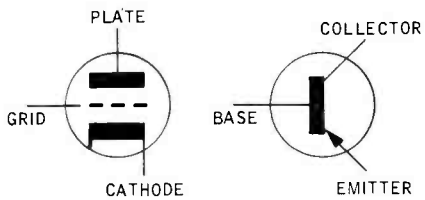


Fig. 1—Comparison of vacuum tube and transistor elements.

This electron flow is progressively reduced as we make the charge on the control grid more negative, until eventually we reach a point called *cut-off*, beyond which further changes in control grid voltages make no significant difference, for the flow of electrons in the tube has virtually ceased.

If we make the grid less negative (which is to say, more positive), we eventually reach another point of diminishing returns called *saturation*, beyond which again no further change in control grid voltage will cause any further increase in the flow of electrons from cathode to plate.

Were the positive peaks of our input signal to drive the tube to saturation, or were the negative peaks to drive it to cut-off, serious distortion would result. This, in fact, is what is meant by *clipping*.

What we've been describing is the simplest type of amplifying tube, the *triode*. There are also *tetrodes*, with one additional grid, and *pentodes*, with two additional grids; the additional grids are merely to improve the tube's performance, and do not affect the basic principle of operation. Frequently, two separate, and not necessarily identical tubes will be found within a single glass (or metal) envelope; examples include the 12AX7 twin-triode, and 7199 triode/pentode.

How transistors work

Transistors are a bit more complex to describe, at least to present. I suspect that by the time writers have had the sixty years of practice describing them that they've had with vacuum tubes, it will seem a good deal easier.

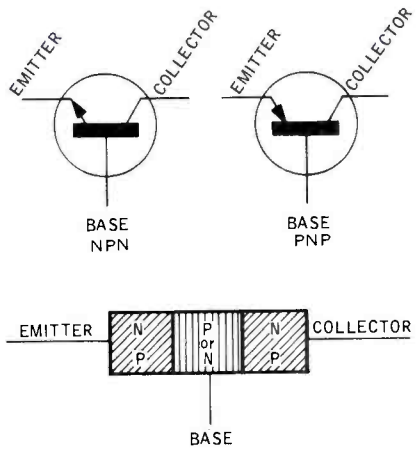


Fig. 2—Construction and schematic representation of n-p-n and p-n-p transistors.

In a transistor, current does not move through a vacuum. Instead, it moves through a substance called a *semi-conductor* that conducts electricity rather too well to be considered an insulator, yet not nearly as well as the conductors, most of which are metals. Germanium and silicon are the commonest semiconductors in use. In their absolute pure states, and at low temperatures, they do not conduct at all, but in transistors, they are carefully *doped* with minute amounts of various impurities. Typical impurities are arsenic, phosphorous and intimony (donors) or boron, aluminum and gallium (acceptors).

N-type and P-type

When germainum or silicon are doped with donor atoms, we get an *n-type* semiconductor, with a surplus of electrons (negative) that can travel freely through the semiconductor material. By doping with acceptor atoms, we get a *p-type* (positive) semiconductor; traveling through it are "holes," not electrons. Here's where an electron can fit—each, in effect, a positive "particle" equal and opposite in charge to an electron. These holes, too, can travel, and the movement of either negative electrons or positive holes constitutes a current flow.

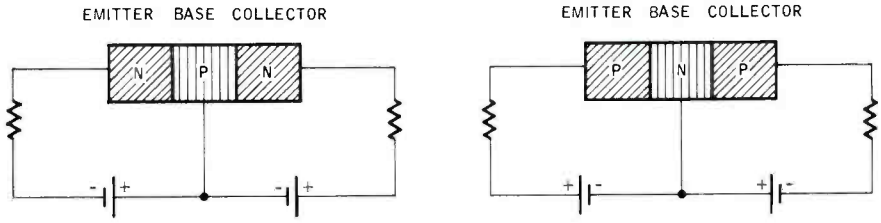


Fig. 3—Correct biasing of n-p-n and p-n-p transistors. Note reversed polarities.

Semiconductor sandwiches

A transistor is a sandwich, with two thick, heavily-doped semiconductors of one type as the bread surrounding a thin, lightly-doped semiconductor filling of

(Continued on page 6)

WE DON'T GUARANTEE THAT THE DYNATUNER WILL OUTPERFORM ALL OTHERS . . .

KIT 99.95
ASSEMBLED 154.95

But we can be confident that you can spend far, far more for an FM Stereo tuner and not receive more stations than you can get with a Dynatuner. Its low distortion and superior quieting will give complete listening satisfaction in comparison with the most expensive competitive units.

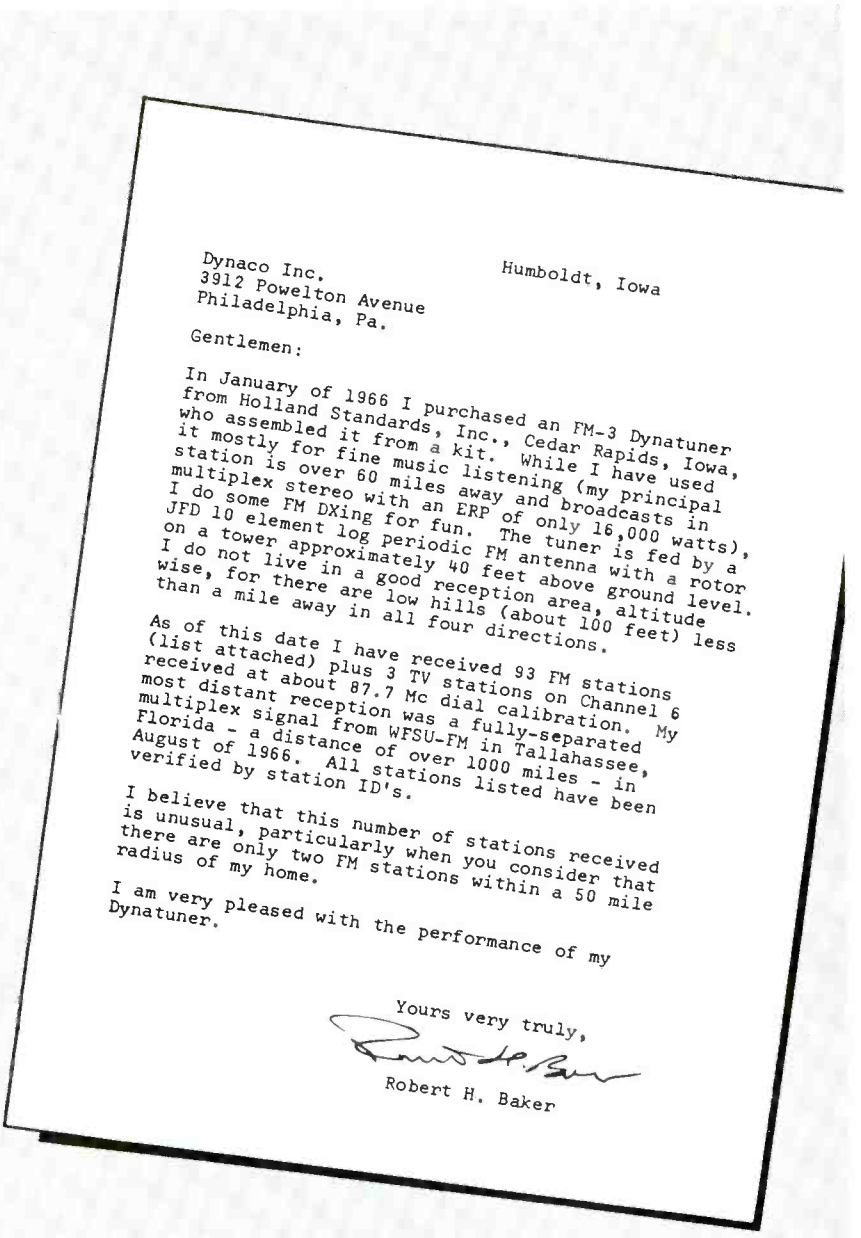
Perhaps our specifications are somewhat confusing. How can our modest 4 μv IHF sensitivity compare with advertised claims which superficially appear to offer far greater sensitivity? Well, the answer is rather complex because effective sensitivity is not fully described by one measurement. It is the actual in-the-home performance which counts, though, and Mr. Baker's letter is just one of many examples of the Dynatuner's outstanding capability.

Because specifications measured under laboratory conditions do not relate directly to the reception problems encountered in the home, only an on-the-scene comparison can establish relative performance. Since this is not always possible, follow the lead of tens of thousands of satisfied users, and

TRY A DYNATUNER

More Dynatuners are in happy owners' homes than any other brand. It's just as easy to use as it looks. Tuning indication is precise, it automatically switches to stereo operation when you tune to a stereo broadcast, and drift is a thing of the past. Dynaco concentrates on performance.

. . . Shouldn't you?



Dynaco Inc. Humboldt, Iowa
3912 Powelton Avenue
Philadelphia, Pa.

Gentlemen:

In January of 1966 I purchased an FM-3 Dynatuner from Holland Standards, Inc., Cedar Rapids, Iowa, who assembled it from a kit. While I have used it mostly for fine music listening (my principal station is over 60 miles away and broadcasts in multiplex stereo with an ERP of only 16,000 watts), I do some FM DXing for fun. The tuner is fed by a JFD 10 element log periodic FM antenna with a rotor on a tower approximately 40 feet above ground level. I do not live in a good reception area, altitude wise, for there are low hills (about 100 feet) less than a mile away in all four directions.

As of this date I have received 93 FM stations (list attached) plus 3 TV stations on Channel 6 received at about 87.7 Mc dial calibration. My most distant reception was a fully-separated multiplex signal from WFSU-FM in Tallahassee, Florida - a distance of over 1000 miles - in August of 1966. All stations listed have been verified by station ID's.

I believe that this number of stations received is unusual, particularly when you consider that there are only two FM stations within a 50 mile radius of my home.

I am very pleased with the performance of my Dynatuner.

Yours very truly,

Robert H. Baker

A list of the stations Mr. Baker received is obtainable from Dynaco on request, along with two similar tabulations from other users: 125 stations received on a mono Dynatuner in northern New Jersey, and more than 60 stations received in Baltimore, Maryland on a simple indoor folded dipole antenna. All were logged on Dynatuners which were built and aligned from kits. Not all stations were received regularly, of course, nor all at the same time. Antenna position and design as well as atmospheric conditions affect reception, and it is not unlikely that another top-flight tuner might possibly match this performance. If you are spending more than $300, you might well expect such results, but under $100 it is unique.

Complete specifications and a comprehensive report on the Dynatuner is available on request, providing detailed test reports on several different samples for objective evaluation.

dynaco INC. 3912 Powelton Avenue Philadelphia, Pa. 19104

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FUNDAMENTAL AUDIO

Continued from page 4

the other type. N-type bread and a p-type filler make an *n-p-n* transistor; p-type bread and n-type filler a *p-n-p*. In the n-p-n, current is carried by the movement of electrons; in the p-n-p, the major charge carriers are positive charged holes.

The heavily-doped outer sections of the transistor are called the *emitter*, and the *collector;* the thin, lightly-doped section between them is the *base*. We can consider the base as equivalent to a tube's grid, while the emitter and collector are equivalent to the tube's cathode and plate, respectively.

Junctions and biasing

There are two P-N *junctions* in a transistor, where the base meets the collector and the emitter. If a positive charge is applied to the "N" side of the junction, and a negative charge applied to the "P" side, the junction is *reverse-biased*, and very little current will flow through it. But if the junction is *forward-biased*, with a positive charge on the "P" material and a negative charge on the "N" side, a heavy current will flow.

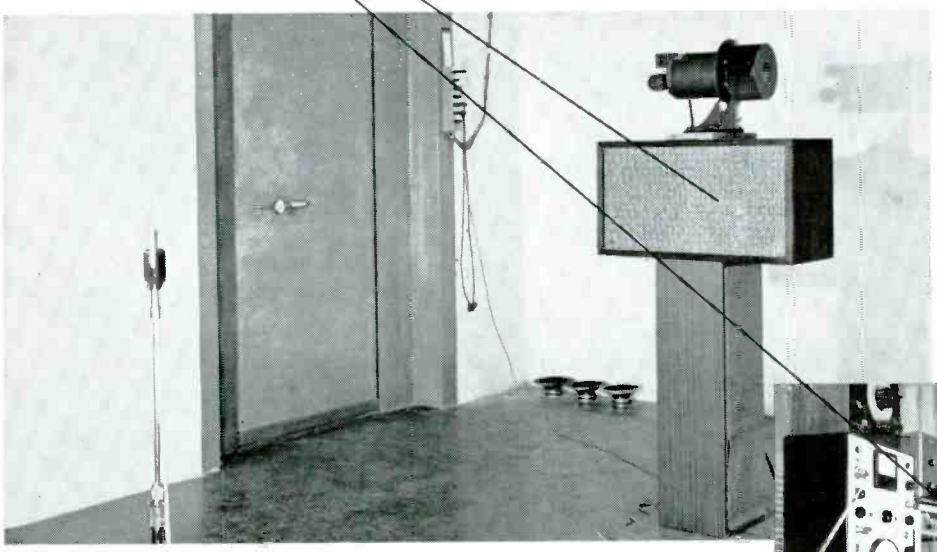
The junction between emitter and base is always forward-biased, while the base-collector junction is reverse-biased. This requires that the base of a p-n-p transistor be positive in relation to the collector, and negative to the emitter; while in an n-p-n transistor, the polarities are reversed, and the base is negative to the collector, positive to the emitter.

Since the emitter-base junction is forward-biased, the electrons (in our n-p-n example) flow freely from the emitter into the base. Some of these electrons will fall into the holes in the base region, combining and neutralizing their respective negative and positive charges. But since the base region is both smaller and less heavily doped than the emitter and collector, the number of electrons migrating across the border is far greater than the number of holes in the base.

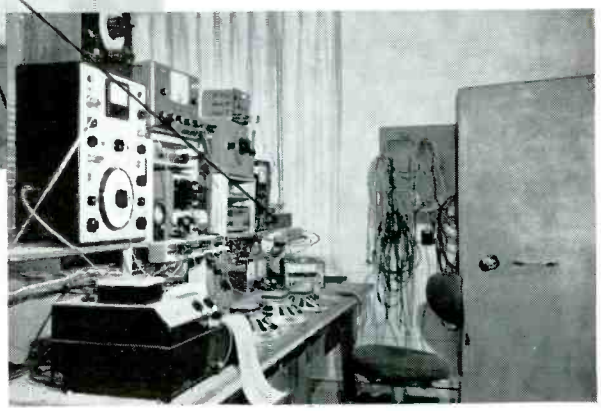
The base-collector junction is reverse-biased: the *collector's* electrons cannot therefore travel into the base, nor can the base's *holes* travel into the collector region. But to free *electrons* in the base region, the base-collector junction appears forward-biased, and they breeze on through into the collector and out again into the external circuit. For an explanation of how a p-n-p transistor works, just substitute the words "hole" and "electron" for one another in the two preceding paragraphs.

The amount of current flow depends upon the forward-bias of the emitter-base junction; a small increase in this forward-bias produces a large increase in current flow. An alternating current injected into the emitter or the base will, of course, vary the forward biasing of this junction. This will cause an equivalent but larger variation in the current flow from emitter to collector, with the same frequency and wave shape as the alternating input signal . . . in other words, amplification.

AR INC. speakers and turntables are used as laboratory measurement standards—



COURTESY PERMA-POWER CO.



Reverberant test chamber and associated laboratory test bench of the Perma-Power Company of Chicago, manufacturer of instrument amplifiers and sound-reinforcement systems. The AR-2a× speaker on the pedestal is used as a distortion standard to calibrate chamber characteristics. This test facility, described in a recent paper by Daniel Queen in the **Journal of the AES**, employs only laboratory-grade equipment. (Note the AR turntable on the test bench.)

but they were designed for music.

COURTESY WABC-FM

Offices of the Vice President and General Manager, and of the Program Director of radio station WABC-FM in New York City. AR-2a× speakers and AR turntables are used throughout WABC's offices to monitor broadcasts and to check records. WABC executives must hear an accurate version of their broadcast signal; they cannot afford to use reproducing equipment that adds coloration of its own.

ACOUSTIC RESEARCH, INC., 24 Thorndike Street, Cambridge, Massachusetts 02141

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AUDIO ETC.

Edward Tatnall Canby

Armstrong II— "The Expense of greatness"

On the night of January 31, 1954, Major Edwin Howard Armstrong, who claimed to be the inventor of workable FM radio transmission, of the superheterodyne circuit found in millions of radios, of the super-regenerative circuit, and (moving backwards in time) the original regenerative vacuum tube circuit of 1912, from which derives the whole of modern broadcasting and communications, plus the whole of modern electronic amplification, dressed himself up as for an evening party, impeccably, and stepped out through the thirteenth floor window of his large New York apartment in River House. His body was found below, the next morning.

Only a year or so later, *Man of High Fidelity*, the Lawrence Lessing biography* discussed in this department last month, was completed—through that dreadful day of infamy in radio-electronics and briefly beyond, to cover the settlement of the estate, the closing down

Major Armstrong is shown working 1,200 feet above the Hudson River, N. Y., on his FM antenna.

his work and of his inventions themselves, has gone onwards as projected in the final pages of his written life. The of Armstrong's pioneer radio station at Alpine, N. J., into which he had poured almost two million dollars and, paradoxically, the first, ironic beginnings of an Armstrong upturn, too late.

Only two months after his death, the British BBC announced a high fidelity FM network that would cover all of their island territory. The U.S. Army Signal Corps dedicated Armstrong Hall at Fort Monmouth, N. J., as a museum of early radio apparatus. Armstrong's recent work in FM radar, which had seemed to be lagging dismally, now picked up energy and moved ahead at his old hangout, Columbia University. But the most important final event that got into the very end of the Lessing biography of 1956 was the settlement of the colossal FM infringement suit, tendered by Armstrong against R.C.A., with payment of almost a million dollars into the Armstrong estate.

Ironic indeed. By his suicide, he won a battle. When he died, Armstrong was on the point of financial disaster. He had been fighting that battle against enormous corporate forces, since 1949, full-time, time-and-a-half. It was the gargantuan straw that finally broke an indominable spirit. Preposterous thought! Imagine an individual—any individual—taking on a top-size corporation on terms of equality; imagine any corporation of such size having to cope on its own grand scale, millions of dollars at stake, with a single, *individual* adversary! That is the drama of the final Armstrong story and, to a slightly lesser degree, the earlier stories of the same sort, notably the endless struggle between the De Forest interests and Armstrong over the original regenerative circuit patent. That battle went on for no less than fourteen years. Armstrong lost it. Against fact.

As we all know, a very great deal has happened since 1956, the year of the Lessing biography of Armstrong. Heartening things, at last. The trend towards "rehabilitation" both of Armstrong's own importance and towards recognition of rest of the story, up to date, has now been added by Lessing. With luck, we'll all soon have a crack at the final new chapter when and if the much-to-be-desired paperback edition appears. (I am personally plugging for it simply because of the importance of the book; I have no connection with the project other than the words in this column.)

What happened after 1956? Well, obviously, the great 1933 FM invention (or discovery) at last found its burgeoning place in radio. Not only public broadcasting, but in a hundred-thousand other areas, most notably in space communications, a field which, Mr. Lessing notes, would really have thrilled the Major's heart.

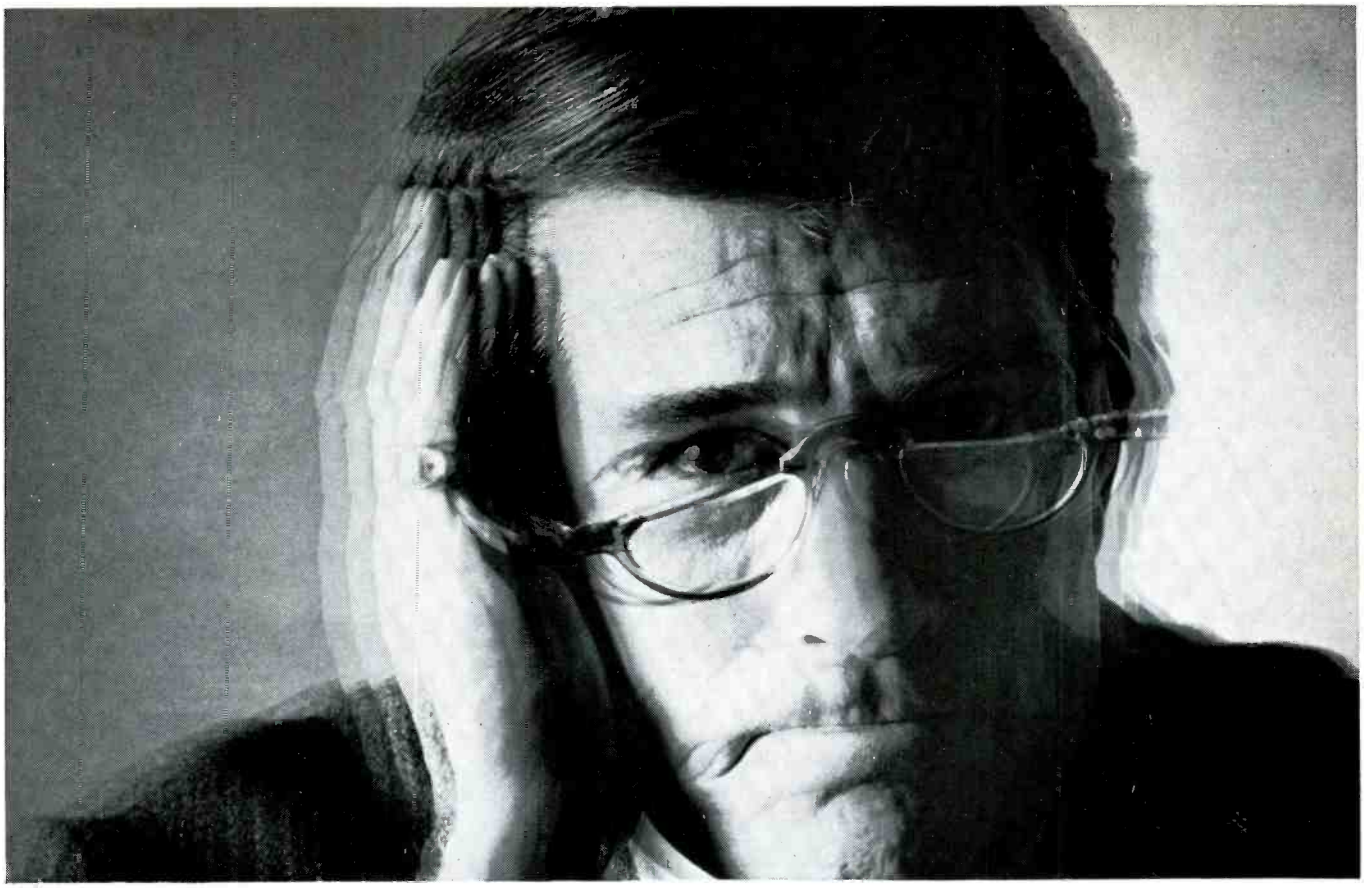
But if he had lived on, where would he be now? Would the same old corporate battles still drag on, would new inventions, new applications (such as

Edwin Howard Armstrong, inventor of FM radio.

space) of his older ideas, merely lead to newly epic legal battles, further denying him his own work, discrediting him further—where, dead and no longer a living menace, he is now at last receiving objective, non-biased recognition? It is the tragedy of the great inventor in an age of corporate might.

He was a bull-headed man, this Armstrong, and a soberly honest one; that was the trouble. The idea of a smooth compromise seemed beyond him. He wanted the truth and nothing but it. He was obstinate. His life was one long fight—but most of the fights were started by him. And they were carried on with every bit of personal force he could

* *Man of High Fidelity: Edwin Howard Armstrong. 1956, J. B. Lippincott, Philadelphia, Pa.*



This will bring out the worst in your high fidelity system

Shure development engineers have created a unique recording that authoritative high fidelity critics call the most significant new test record in years. It enables you to identify certain prevalent distortions that you may have blamed on speaker break-up, pressings, or amplifier overloading for what they really are: tracking distortions brought about by the stylus parting company with the record groove. Comprehensive notes and a working "score chart" guide you through the entire recording. Your own ears are the only diagnosis "instrument" necessary. It will conclusively prove to you the importance of the new specification called "Trackability", and demonstrate the clear-cut superiority of the revolutionary Shure V-15 Type II Super-Track™ cartridge in achieving maximum trackability. Recording TTR 101, "An Audio Obstacle Course" is available directly from Shure for only $3.95. (Residents of Illinois must include Illinois State Sales Tax.) Send your check or money order to Shure Brothers, Inc., Dept. 63, 222 Hartrey Avenue, Evanston, Ill. 60204.

P.S. Incidentally, purchasers of the Shure V-15 Type II cartridge automatically get the record free.

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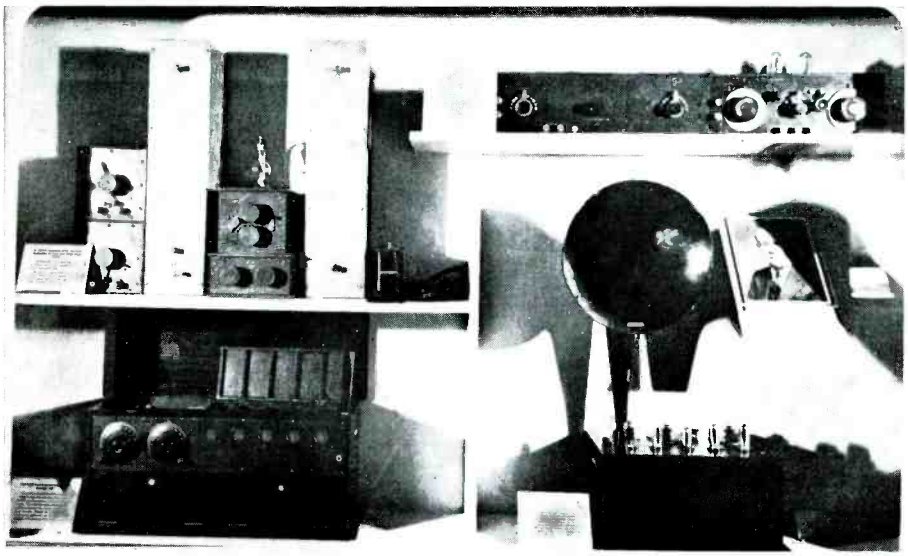
muster, plus all of the large fortune he managed to make in between the corporate wars. He was perhaps the only great inventor who had the financial power (a) to launch his own inventions *in spite* of corporate disinterest, as he did FM, and (b) to fight for his rights at the top corporate level. Not even Edison (who was another fighter) ever managed that. Edison fought for his personal stake in company after company, but it was never quite Edison himself against industry in the sense, and on the scale, of Armstrong's battles.

And so the story of Armstrong is also the story of the modern super-corporation itself, against which he fought, and this is Lessing's most fascinating account. For the power of a giant corporation goes far beyond any individual within its shape; it often turns soullessly upon any person or thing which impedes the basic corporate aims—profit and expansion, control of more and more power.



Shown here are Armstrong's first regenerative or "feedback" radio receiver, and first, second and third superheterodyne receivers.

Even within the corporation, as we should all know by now, its members are at its impersonal mercy, from the botton straight up to the very top.

It was no more possible for the corporate executives to "let Major Armstrong off," so to speak, without a fight down to the last legal phrase, than for a lioness to spare its prey in mid-kill. He was the victim of a monstrous machinery, not of vindictive human beings as individuals.

Even language itself is at the mercy of corporate power dynamically-aroused in its own interest. The very process of legal reasoning, the force through which the battles are joined, can be blandly turned straight against scientific fact. This is Lessing's greatest message for us and all the more so because it is not so much a "good-versus-evil" message as a statement of the dramatic facts of life as they are today. Like a novel, the characters, Armstrong and the corporation, are brought into epic, tragic, legal conflict; that is the real drama.

The corporation, if I read Lessing right, may perhaps be hated and feared, it may do untold damage, it may hold up progress as often as it advances it, but it is not inherently evil; it simply *is*. It exists, it has weight. It has enormous power, and it wants more by a sort of corporate instinct.

And so *Man of High Fidelity* is not really one-sided, though the author passionately feels for his bull-headed, obstinat Major. The Major's long battle, so often downhill and backwards, is the more poignant because of this fairness (again, as I read it) with which the other side is treated. Though he is *very* far from agreeing with the anti-Armstrong arguments, Lessing presents them, exhaustively. I doubt if we will ever have a fairer exposition of the facts and the claims.

Perhaps the most interesting argument that emerges from this book is one we all hear about these days—the inability of the corporate kind of team laboratory research to come up with the sort of basic intuition that has governed the great inventions of history until now. It's a fascinating question—for certain kinds of invention do, indeed, come out of team research, and more so in every year of our increasingly complex progress. The computer itself, I'd guess, is a case in point. Transistors? Integrated circuits? Nuclear fuelings? Assorted missiles? Team work, all.

These and a thousand other inventions are irrevocably corporate in nature; no individual could conceive or finance them whole. But are they really *inventions*? Basic discoveries?

Again and again, the materials for a *basic* invention have been at hand, practically under our noses, and no one has seen the light, until the right mind suddenly puts the parts together. Edison didn't invent the electric light, nor even the phonograph, nor did Morse invent the telegraph. Each of them did put two and two together, out of others' groupings, to make a definitive, *workable* product, to shape a new area, a principle which, like Edison's Pearl Street power plant in New York and its integrally designed high-voltage bulbs, can become the matrix for enormous future undertakings.

Simultaneous Discoveries

It is one of the curious miracles of science that, time and time again when conditions are exactly ripe, *two* inventors—often more—simultaneously come upon the same idea, within days, even hours of each other. It has happened astonishingly often, so often that no scientific "explanation" can dull the miracle of it.

So it was with Bell and Gray, the telephone men. So, too, with Faraday's discovery of electrical induction in England and the same discovery, here in America (though less well known) by our own Joseph Henry. In 1745 two men simultaneously discovered the principle of the storage capacitor for electricity; one was an amateur, a Bishop von Kleist in Germany, the other a professor by the name of Van Musschenbroek in Leyden, Holland.

The first to report in each case got the credit—Bell, Faraday, the Leyden experimenter. (Hence the Leyden jar.) Whether it's a patent application or the original written-down sketch of an idea, the time factor counts crucially—and often it has come down to a matter of minutes. After centuries.

How often does a *research team* find its discovery simultaneously discovered by another team? Oddly—quite often. For we are now talking of that moment of ripeness, not so much of the individual inventor. And yet—the inventor's mind is still essential, even now. Or it was, as long as Armstrong lived. No team ever matched his extraordinary *basic* circuit inventions.

Is it not the *basic* invention that belongs to the individual genius, whereas the team is splendid for the Before and the After—for the preparation of the cosmic moment, the ripeness, and for the following-up that comes later, the development and expansion?

Are there not inventors even within our teams—and doesn't the basic discovery always come from the one, brilliant mind that seizes the ripeness and *individually* hits upon the solution to the problem? That's my idea, anyhow. But you'll find plenty to illuminate it in the Armstrong biography.

Never forget that De Forest invented the vacuum-tube triode in 1906 but there was no real use for it, in spite of the whole swarm of radio-enthusiasts at work, until 1912 when a young engineer, still short of his student degree, worked out his idea of a receiving circuit to put it to use—and at the same time proceded to explain what really went on

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inside the tube. That was Armstrong, the genius-individual. Still an inventor on his own. The last?

* * * * *

The date was November 5th, 1935, a date to remember. The meeting on 39th Street in New York was that of the Institute of Radio Engineers (I.R.E.) for a talk on "A Method Reducing Disturbances in Radio Signaling by a System of Frequency Modulation," presented by the well-known Major Armstrong. Some readers of this department of our magazine were undoubtedly on hand for that historic occasion.

On that day, the Major—a first-rate dramatic ham, always—put on a surprise FM broadcast demonstration for the I.R.E. members, right in front of their ears and eyes. *In 1935!* It took almost 25 years for FM broadcasting to live up to that occasion. Let me quote Lessing and, thus, give you a bit of the flavor of my current favorite book.

"For a moment the receiver groped through the soughing regions of empty space, roaring in the loudspeaker like surf on a desolate beach, until the new station was tuned in with a dead, unearthly silence, as if the whole apparatus had been abruptly turned off. Suddenly out of the silence came Runyon's supernaturally clear voice:

'This is amateur station W2AG at Yonkers, New York, operating on frequency modulation at two and a half meters.'

"A hush fell over the large audience. Waves of two and a half meters (110 megacycles) were waves so short that up until then they had been regarded as too weak to carry a message across the street. Moreover, W2AG's announced transmitter power was barely enough to light one good-sized electric bulb. Yet these shortwaves and weak power were not only carrying a message over the seventeen miles from Yonkers, but carrying it by a method of modulation which the textbooks still held to be of no value. And doing it with a life-like clarity never heard even on the best clear-channel stations in the regular broadcast band. . . . A glass of water was poured before the microphone in Yonkers; it sounded like a glass of water (in New York) and not . . . like a waterfall . . ."

So it goes on. Old stuff today! But when did *you* first hear that sort of clarity? I heard it eons ago, in the summer of 1942. FM—perfected FM—was then already nine years old.

When the Major died, FM was *twenty one*. And he died in the midst of trying to prove that he had invented it, and that it was useful. Still. After so long.

That, as Arthur Lessing points out, is the expense of greatness. P.S. The major's great invention is now, at last, getting off the ground. It's a success, FM! At the age of thirty four. Æ

Letters from Readers

Tape-type Reverb Unit

Sir:

I was surprised to find . . . May "Letters" column mentioned Fisher as the only one now making any reverberation equipment for hi-fi performance. The Schober Reverbatape Unit, a tape-type artificial reverberator, has for several years been . . . available for both organs and music systems . . . applies reverberation to the entire audio spectrum. It is, of course, higher in price than devices such as Fisher's, which use the Hammond springs, but it does not have . . . audible limitations inherent in spring systems.

RICHARD H. DORF
The Schober Organ Corp.,
New York, N. Y.

The Reverbatape Unit is also available in kit form—ED.

Sweet Smell of Success

SIR:

The March 1967 issue had a question [Tape Guide column] about d.c. braking instead of mechanical braking.

I know for a fact that d.c. braking is not only far simpler, but far superior to mechanical forms of braking. You state . . . if these brakes are left on too long, the motor will begin to smell. I have left the d.c. braking on for hours with never the slightest trace of odor.

EDWIN SCHWARZ
Warwick, R. I.

Seeks Amplifier Design Book

SIR:

I am having difficulty finding a book that gives a good method for the design of amplifiers, both tube and transistors. Assistance would be greatly appreciated.

HYMAN GOLDSTEIN
New York, N. Y.

There are many design *books available from numerous text book publishers. Suggest you visit your local public library and examine a directory of text books to determine which ones may be desirable.* Radiotron Designer's Handbook *might be helpful to you, though design information is restricted to vacuum tube technology. Don't overlook one of the best sources for design information: component manufacturers' manuals. General Electric, Motorola, Radio Corp. of America, Texas Instruments, and others offer a wealth of design information at reasonable prices.*—ED.

Author Improves Article

SIR:

Here's how to improve my article on Decibels [June, 1967 AUDIO] by changing one value.

By changing the one value given for 1 dB from "1.26" to '1.25', the last value equates with '1¼' or with '5/4.' Either of them can be handled mentally with ease.

To apply this advantage, let's start with the basic dB Table, the origin of which is given clearly in the article. But let's start the table by realizing that *no change* means *0 dB change*. That is, you still have all you start with (= '1'):

0 dB =	1	
3 dB =	2	
6 dB =	4	(Any change of *3 dB*
9 dB =	8	will either *double or*
12 dB =	16	*halve* the associated cor-
15 dB =	32	responding value of the
18 dB =	64	power ratio)
21 dB =	125	
24 dB =	250,	
etc.		

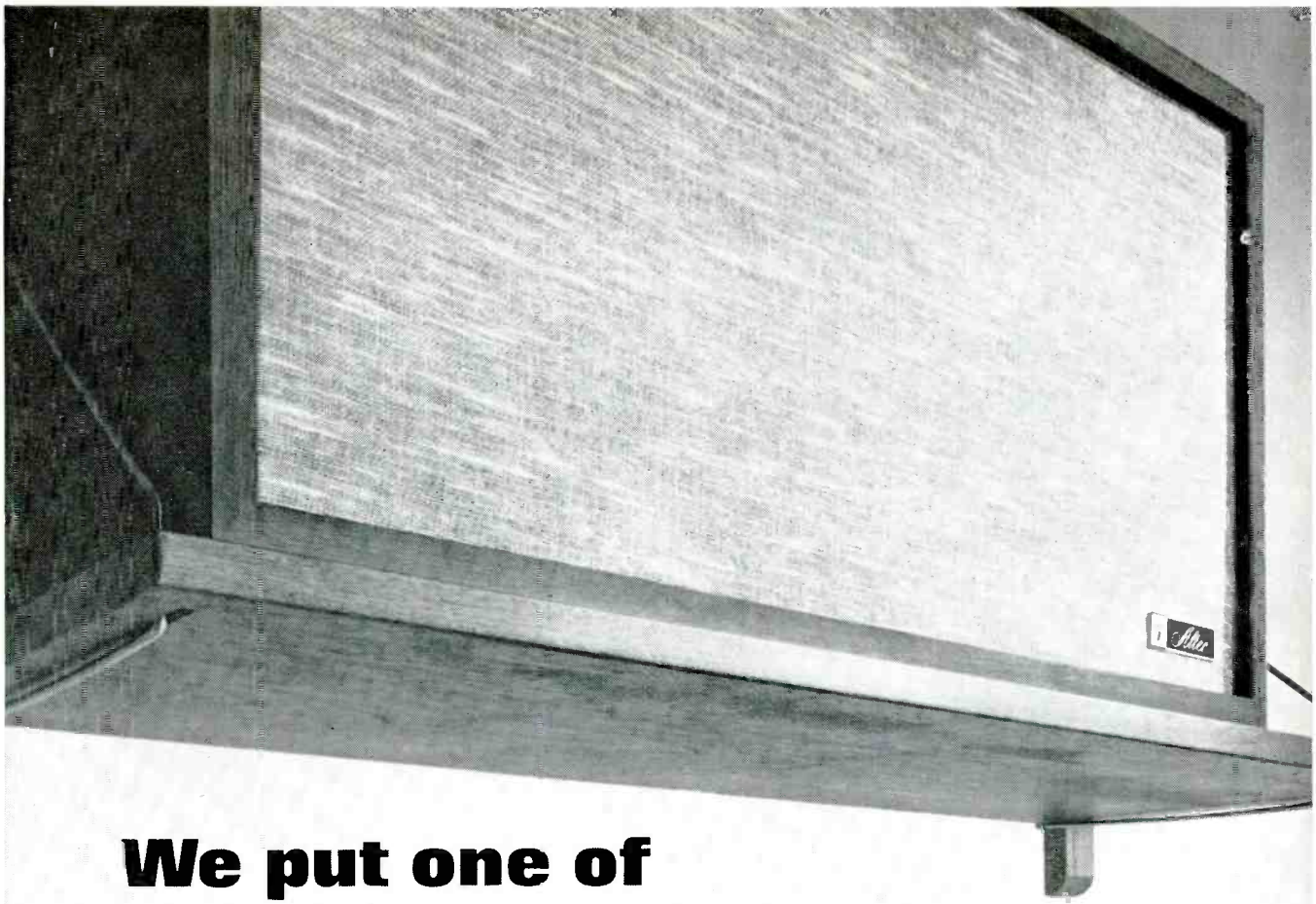
Between any pair of adjacent equations in this basic table, there can lie *only two* other equations for the table to skip no integral (whole-number) dB value. For instance, between *9 dB* and *12 dB*, there can lie *only two* other values: *10 dB* and *11 dB*. What values do their power ratios have?

To obtain the first (for 10 dB), simply increase the value found for 9 dB, *by ¼*, i.e., ¼ of 8 = 2; 8 + 2 = 10. So *10 db = 10.*

To obtain the second (for 11 dB), simply decrease the value for 12 dB *by ⅕*: ⅕ of 16 = 3⅕; 16 − 3⅕ = 12⅘ = (practically) 13. So, *11 dB = 13.*

In that simple way, the values for any two power ratios may be filled-in on the basic dB table.

GEORGE O'DONNELL
Sumter, So. Carolina



We put one of our best ideas on the shelf.

Over the past 30 years, we've had a lot of good ideas about speaker systems. Some of them ended up in Cinerama, in the Houston Astrodome, in Todd A-O, and places like that.

This one ended up on a shelf. (Or a lot of shelves, matter of fact.)

Which is where you'd expect to find a 2 cubic foot speaker. Only the Bolero isn't just another small-size speaker, with a small-size sound. It's different.

What makes it different is that part of this speaker isn't what it seems to be. There appear to be two woofers, but one of them is actually a free-suspension phase inverter.

So?

So it's tuned to work in precise phase with the woofer. And as a result, you get a bass response that few large systems could match.

The true woofer is a full 10", with a massive 10-lb. magnetic structure that makes the Bolero as efficient as a big speaker. With one watt of input, you get a rousing 92 dB of sound. Clean sound, no matter how loud you play it. Powerful sound, even with a medium-power amplifier.

Then Altec's 3000H multicellular horn and driver handles the highs without shrillness, shriek or quaver. In addition, a built-in 3000 Hz dual element crossover network with variable shelving control gives you precise frequency separation.

We didn't stint on the styling, either. The cabinet is hand-rubbed walnut, finished on all 4 sides so you can show off the Bolero any way you want to. And, just to please the hard-to-please, we made the grille a snap-on, so you can change the grille cloth to suit your mood or decor. Any time.

The Bolero fits almost anywhere. ($14\frac{1}{2}$" x $25\frac{3}{4}$" x 12".)

It also fits almost any budget at just $169.50.

Give it a listen at your Altec dealer's. And while you're there, ask for your free 1967 Altec Stereo catalog. Or write us for one. You can keep it on the shelf next to your Bolero speaker.

ALTEC LANSING

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EDITOR'S REVIEW

DAVID AND GOLIATH: ROUND TWO

ANYONE WHO ATTENDED meetings of the hi-fi component manufacturers' ad hoc group on FM multiplex doubtlessly thought that Murray Crosby's proposal for an FM stereo system was, if not a "shoo in," certainly a leading contender. As it turned out, you know, the General Electric-Zenith Radio system of FM multiplex was adopted, leaving all others in the dust.

Therefore, it's interesting to note that a New York Federal judge recently ruled the Crosby FM patent as being valid in a Crosby suit against General Electric. The judge observed that a number of characteristics of the Crosby patent were not found in prior systems, including: monophonic compatibility and high fidelity with separation at all frequencies.

But this isn't the only little guy vs. giant corporation battle still churning. In line with Edward T. Canby's column on Edwin Armstrong in this issue, would you believe that there are still court actions over Armstrong's FM patents to this day? Motorola lost an appeal in the U.S. Court of Appeals only a few month's ago to rehear an appeal on a judgement that the corporation infringed upon three patents owned by the late Edwin H. Armstrong. Armstrong had sent notices of infringement to Motorola in the 1940s, waving enforcement of patents during World War II years, the court said. Three patents are involved: (1) for a synchronous heterodyne FM reception method; (2) preemphasis and de-emphasis FM system; (3) a wideband FM system.

Round three coming up.

LOS ANGELES HI-FI MUSIC SHOW DATES CHANGED

L. A. Show dates have been moved from October 25 through October 29 to new dates of November 1 through November 5, giving IHF Show exhibitors a breathing spell between the big New York Show and the West Coast one.

MORE ON SHOWS

Purely local shows come in for some of the action, too, from time to time. An interesting show twist was provided by a dealer recently in AUDIO'S home town, Philadelphia. Almo Radio Co., a local retail chain, presented an open-to-the-public high fidelity show at the Benjamin Franklin Hotel. Hi-fi equipment displayed consisted of product lines carried by the retailer. Naturally, this restricted the number of brands exhibited, but as an extension of the dealer's showroom, plus exposing many people to hi-fi components, it served its purpose well. Equipment exhibits were staffed by factory and local manufacturers' representatives as well as by the retail store's sales personnel. Seminars and lectures on high fidelity and stereo added spice to the show. On-the-spot dealer sales which, after all, was the motivating drive behind the show, added the jingle of a cash register to the sound of music.

Following the lead set by the Southern California Chapter of the Electronic Representatives Association, the New York Chapter's Audio Division flung itself into the "show biz" world with a commercial sound trade show of its own. Its exhibit was held May 4-5. The Southern California Chapter will present its "Sound Business Show" on November 16-17 at the Olympian Motor Hotel, Los Angeles, California.

The 1967 New England Hi-Fi Show, sponsored by the New England Chapter of E. R. A., will be held at the Parker House, Boston, November 17 through November 18.

STEREO-ONLY RECORDS

There is nothing miraculous about burying monophonic records and producing only stereophonic records. Countries on the continent of Europe enjoy this "compatibility" right now. But they have had adequate vertical compliance mono cartridges for years—and compatibility is in the cartridge, not the record! Now, United Kingdom's E. M. I. (Electrical & Musical Industries), world's largest record manufacturer, has announced that, commencing this month, July, they will produce classical records only in stereo versions. Estimates indicate that 50% to 60% of regular classical-record buyers in the U.K. purchase stereo records, though this represents but 20% of total record sales.

But this move is not being greeted happily by one and all. One British publication, *Electrical and Electronic Trader,* decries the decision, explaining that thousands of pickups [mono] in the U.K. have virtually no vertical compliance.

Wonder how many U.S. mono pickups there are with very low vertical compliance. Wouldn't it be nice to eliminate mono records here, meanwhile reducing the price of stereo versions to mono prices? In fact, even retaining mono records (live and let live, I say), shouldn't stereo-record prices be reduced to that of mono versions? Tapes for records aren't recorded monophonically, we all know. And a master-to-mother-to stamper process costs no more for stereo than for mono records. So why the surtax on stereo records?

P.S. Wouldn't you know that, as we go to press, CBS Records and RCA Victor record division both *raised* the price of of mono LPs to the same price as stereo LPs.

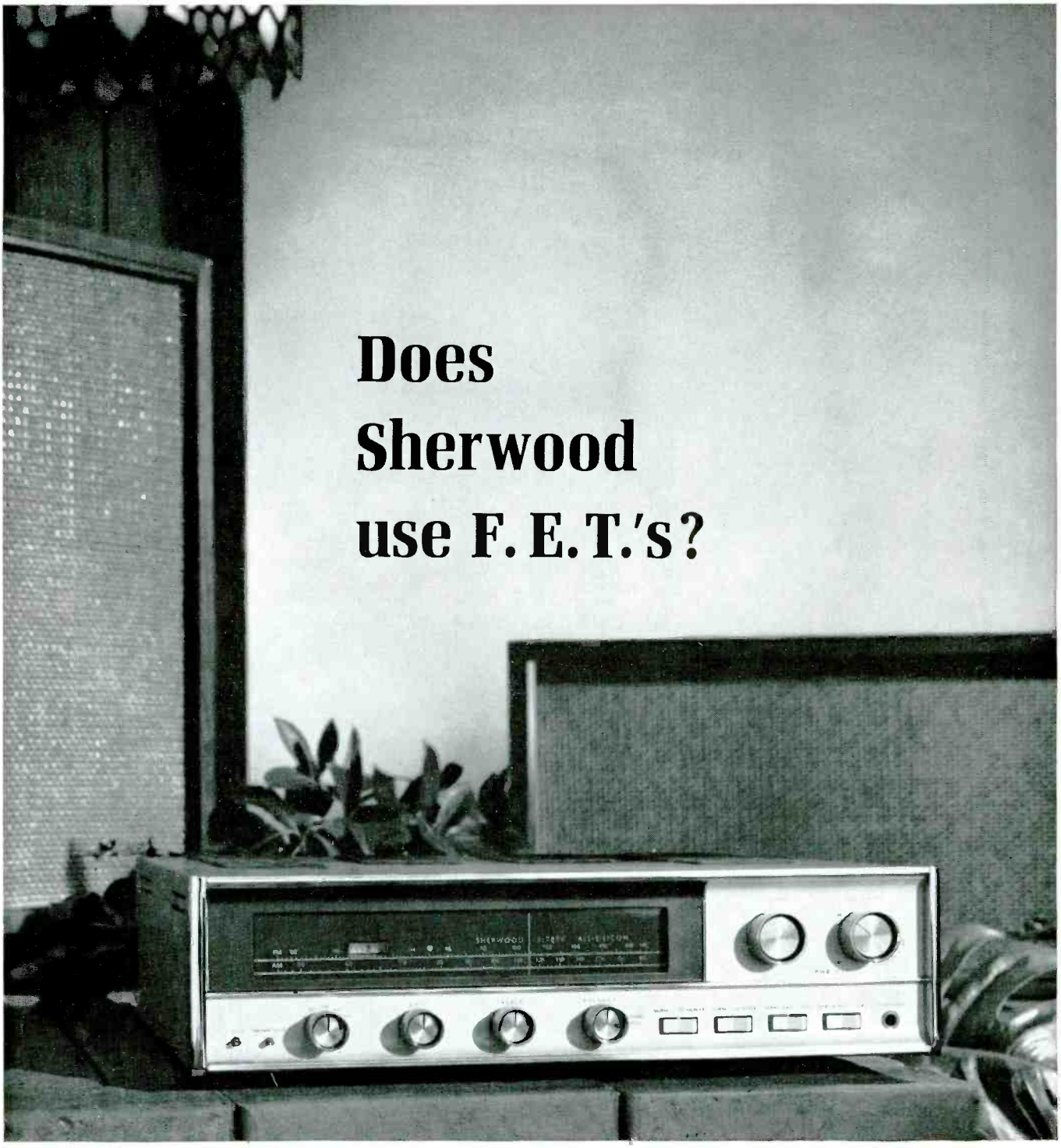
Dustamatic:

the cartridge that cleans the grooves while it plays.

The new Pickering V-15/3 Micro-Magnetic™ stereo cartridge proves that cleaner grooves combined with cleaner tracing result in cleaner sound. The built-in Dustamatic™ brush assembly automatically sweeps dust particles from the groove before the stylus gets there; and the new moving system reduces tracing distortion close to the theoretical minimum, thanks to Dynamic Coupling of the stylus tip to the groove. There are four "application engineered" Pickering V-15/3 Dustamatic models to match every possible installation, from conventional record changers to ultrasophisticated low-mass transcription arms. Prices from $29.95 to $44.95. For free literature complete with all details, write to Pickering & Co., Plainview, L.I., New York.

For those who can hear the difference. **Pickering**

COMPARE THESE NEW SHERWOOD S-7800-FET FEATURES AND SPECS! *ALL-SILICON* RELIABILITY. INSTAMATIC OUTPUT OVERLOAD PROTECTION CIRCUITRY. NOISE-THRESHOLD-GATED AUTOMATIC FM STEREO/MONO SWITCHING. FM STEREO LIGHT. ZERO-CENTER TUNING METER. FRONT-PANEL FM INTERCHANNEL HUSH ADJUSTMENT. MONO/STEREO SWITCH AND STEREO HEADPHONE JACK. ROCKER-ACTION SWITCHES FOR TAPE MONITOR, NOISE-FILTER, MAIN AND REMOTE SPEAKERS DISCONNECT. MUSIC POWER 140 WATTS (4 OHMS) @ 0.6% HARM. DISTORTION. IM DISTORTION 0.1% @ 10 WATTS OR LESS. POWER BANDWIDTH 12-35,000 CPS. PHONO SENS. 1.8 MV. HUM AND NOISE (PHONO) —70 DB. FM SENS. (IHF) 1.8 μV FOR 30 DB QUIETING. FM SIGNAL-TO-NOISE: 70 DB. FM CAPTURE RATIO: 2.4 DB. FM CROSS-MODULATION REJECTION —95DB. DRIFT = .01%. AM SENS. 2.0 μV. AM BANDWIDTH 7.5 KC. 45 SILICON TRANSISTORS PLUS 16 SILICON DIODES AND RECTIFIERS. SIZE: 16½ X 14 IN. DP.



Did you think because Sherwood makes such beautiful receivers we would neglect Field-Effect-Transistor circuitry? The new Sherwood *ALL-SILICON* Model S-7800-FET FM/AM 140-Watt Receiver shown above has been specially designed for urban strong-signal locations.* This *ALL-SILICON* receiver offers unexcelled FM reception in areas where powerful local stations can interfere with the reception of distant and weaker stations. The Model S-7800-FET also features two separate front-panel rocker switches for multiple speaker installations throughout your home. Write for a complimentary copy of the new Multiple-Speaker Installation manual.

*Specially-selected Field-Effect Transistors in RF and Mixer stages of S-7800-FET improve cross-modulation rejection almost 10 times (20 db

S-7800-FET 140-watt FM-AM *ALL-SILICON* Receiver
$409.50 for custom mounting
$418.50 in walnut leatherette case
$437.50 in hand-rubbed walnut cabinet

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The new NAB magnetic tape standards

Part 1

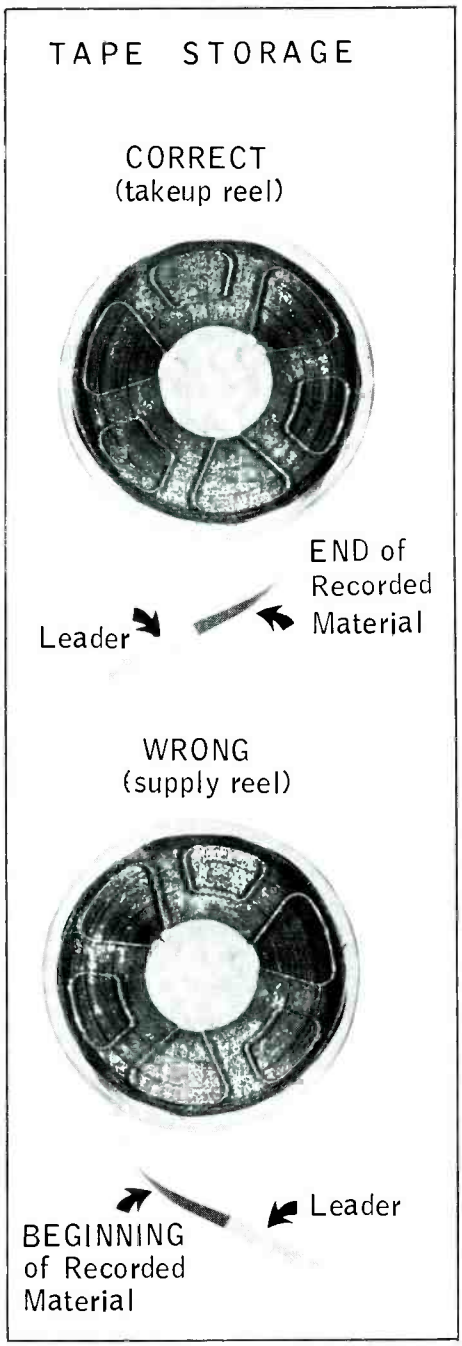
HERMAN BURSTEIN

The National Association of Broadcasters' reel-to-reel magnetic tape recording and reproducing standards are examined in depth. Comparisons with older NAB standards and current RIAA practice place today's NAB standards in proper perspective.

IN JUNE 1953, NAB (National Association of Broadcasters) issued *Recording and Reproducing Standards* for magnetic (and disc) recording. Over the next dozen years a gap gradually developed as these standards were outstripped by advances in a relatively new art—better tape, better heads, better electronics, better transports, in-line stereo heads, quarter-track format, etc. Many in the industry tended to follow the practices of its leaders so that a set of shared practices grew up amounting to de facto standards. However, there was not the degree of conformity that official standards command and that work to the advantage of the consumer. To illustrate, for a long time the purchaser of prerecorded tape could not be sure that it would be matched by the playback characteristic of his tape machine to yield flat frequency response. To close the gap, the NAB issued in April 1965 *Magnetic Tape Recording and Reproducing Standards, Reel-to-Reel.*

Standards can be very confusing. In this and succeeding articles, we shall try to clarify these standards, closing the information gap suffered by many tape enthusiasts by discussing the new NAB standards. We shall dwell on all points that we believe are of interest and significant to the home tape recordist. Where appropriate for a complete view of a point, we shall compare the new standards with the old, as well as with *Standards for Magnetic Tape Records* issued by RIAA (Record Industry Association of America, Inc.) in July 1965. Whether directly quoted or paraphrased, the new NAB standards are indented to separate them from our comments.

To catch our errors in interpreting the 1965 NAB standards, Mr. John G. McKnight, an Ampex Staff Engineer who participated in developing these standards, has been kind enough to review our discussion. However, responsibility for any remaining errors and for comments on the standards is solely ours.



Magnetic Tape Dimensions

The 1965 NAB standard sets the width at 246 mils ± 2 mils.

Thus the tape may vary between 244 and 248 mils. The rated width of 246 mils agrees with the 1965 RIAA standard and with industry practice since 1959. The 1953 NAB standard permitted a broader range, 244 to 250 mils. Narrowing the range of tape width helps reduce problems of incorrect azimuth and of poor tape-to-head contact due to tape skewing or cupping as it passes through guides too wide or too narrow.

Total thickness of magnetic tape may not exceed 2.2 mils. Standard reel diameters, hub diameters, and minimum lengths of tape to be supplied on these reels are:

Reel Diameter	*1.5 Mil Base*	*1.0 Mil Base*
3″	125 ft.	200 ft.
5	600	900
7	1200	1800
10.5	2500	3600
14	5000	7200

Tape with a ½ mil base is "not recommended" except for the 3-inch reel supplying 300 feet.

Tape Uniformity

For constant signal level applied to the tape the signal level recorded on the tape shall be "uniform within ± 0.5 dB throughout a given reel." The test speed is 7½ ips, and the test signal is 400 Hz, recorded at a level matching the "NAB Standard Reference Level."

This level is a specified tone on a special test tape, to be discussed later in connection with signal-to-noise ratio.

Bias is adjusted to obtain maximum recorded 400 Hz signal by playing back the tape and using a standard VU meter that reads average output.

Magnetic Tape Wind

The tape shall be wound with the oxide-coated surface facing toward the hub of the reel. Recorded tape normally should be wound so that the start of the

program material is at the outside of the reel.

This "head out" or "tail in" winding permits the tape to be played immediately. However, for long storage and for other reasons, the NAB standard advocates "head in" winding; now the end of the program is at the outside of the reel, so that the tape must be rewound before it can be played. Tapes stored in this manner shall be clearly marked to prevent accidental playing in the reverse direction.

A footnote explains that tapes stored "head in"

> will have slightly less preprint than postprint. This is generally desirable because postprint tends to be masked by the program material and reverberation effects. Also, rewinding a tape immediately before playing tends to reduce print-through. Another advantage of rewinding before playing is that stresses are relieved and any adhesion of adjacent layers will be eliminated. A further advantage is that tape wound on the take-up reel in the play mode of operation usually is wound more smoothly than when wound at high speed. Therefore, there is less chance of damage during storage or shipment or due to temperature and humidity changes.

However, smooth winding can also be had with "head out" storage. A tape recorded and played in both directions, as is common in the home, will enter storage slowly and smoothly wound. In the case of one-way tape, if time is no problem, the tape can be slowly rewound by putting it through the playback process.

Four-Track Stereo Format

> When tape is first unwound from the supply reel and moves from left to right with the coated side facing away from the observer, the track numbers from top to bottom are 1, 2, 3, 4. Tracks 1 and 3 are used simultaneously for one direction of tape travel; tracks 2 and 4 for the other. Tracks 1 and 3 are used first. Tracks 1 and 4 carry the recording for the left channel, as viewed by an audience; tracks 2 and 3 carry the recording for the right channel. Tracks 1 and 3 (and similarly tracks 2 and 4) are recorded with in-line gaps, producing in-phase signals on the tape.

The in-phase requirement means this: If stereo playback equipment produces in-phase signals from a full-track tape, it will also produce in-phase signals from properly recorded stereo tracks. (Mr. McKnight adds: Although not so indicated in the NAB standard, the phasing specification only applies to low frequencies.")

The four-track stereo provisions agree with the RIAA standard. The latter further requires leaders at least 3 feet long at each end of a recorded tape. If these leaders are used for identification, RIAA states they are to be yellow at the beginning (start of tracks 1 and 3) and red at the end (start of tracks 2 and 4).

The NAB standard is quite clear as to track width but less clear as to width of the islands between tracks.

> The recorded tracks for four-track recordings shall be 0.043 + 0.000 −0.004 inches in width. The center-to-center distances between tracks 1 and 3, and between tracks 2 and 4, shall be 0.134 + 0.002 −0.000 inches. The four tracks shall be equally disposed across the tape with a tape width of 0.244 inches and the outer edges of tracks 1 and 4 coincident with the edges of the tape.

The pieces of this puzzle apparently can be put together as follows:

1. Track width shall be between 39 and 43 mils.
2. The distance between the top of track 1 and the bottom of track 4 shall be 244 mils, corresponding to minimum tape width.
3. The 4 tracks shall be of equal width, and the 3 islands between tracks shall be of equal width.
4. Inasmuch as the 4 tracks can occupy between 156 mils (4 × 39) and 172 mils (4 × 43), the 3 islands share what remains from a total of 244 mils—between 72 and 88 mils. Dividing this remainder by 3, island width can vary between 24 and 29⅓ mils, depending on track width.

But a piece of the puzzle seems left over: the NAB center-to-center provision. From the center of track 1 to the center of track 3 equals a span of 2 tracks and 2 islands, which may total 134-136 mils; hence 1 track plus 1 island may total 67-68 mils. However, this provision seems redundant in view of Point 4 above. According to Point 4, a maximum track width of 43 mils requires an island width of 24 mils so that 4 tracks and 3 islands will exactly fill 244 mils; thus a track and an island total 67 mils. And a minimum track width of 39 mils requires an island width of 29⅓ mils, for a total of 68⅓ mils. So the center-to-center provision appears unnecessary; to boot, it presents a trivial contradiction involving ⅓ mil.

The RIAA standard is essentially the same as the NAB one except that RIAA does not require total track span to be exactly 244 mils. Instead it sets 244 mils as a maximum. RIAA also makes the center-to-center provision, which now is necessary to define island width. Accordingly, depending on track width, island width may vary from 24 to 29 mils, and total track span may vary from 240 to 244 mils.

The differences between the NAB and RIAA track requirements are very minor and present no significant problem as to correspondence of tracks under the two standards.

It may be noted from the foregoing that the tape (246 mils) is slightly wider than the space spanned by the head gaps (244 mils). Mr. McKnight points out that "the purpose for recommending head width *less* than the tape width is to eliminate the problem of 'grooving' of the head at the edge of the tape. If the tape edge is outside of the core, no groove is produced, and the need for re-polishing the face of the head is eliminated."

Two-Track Stereo Format

Under the NAB standard a four-track stereo head is incompatible with two-track stereo recording, unless there is provision for moving the head down. Whereas the lower gap of a four-track stereo head will nominally span the region 134-177 mils from the top edge of a 244 mil tape, track 2 of a two-track stereo recording nominally begins 159 mils from the top. Thus 25/43 of the lower gap will span unrecorded space, with consequent serious deterioration of signal to noise ratio—unless the head can be moved down for two-track stereo.

On the other hand, the RIAA standard permits, though it does not require, compatibility. A specific track width is not stated; only a minimum island width of 30 mils is provided. In this case, track 2 of a two-track recording begins 137 mils from the top of a 244 mil tape, corresponding very nearly with the lower gap of a four-track stereo head, which starts 134 mils from the top.

Mr. McKnight comments: "It was felt that two-track should be considered a 'professional mastering' format, and that to degrade crosstalk by narrowing the island, in order to have reproducibility on home equipment, was not in the best interests of the broadcasting industry. The RIAA specification . . . I'm sure, is to allow two-track/four-track compatibility, especially on home-grade two-track recorders. There's nothing to say that U.S.A. two-track recorders for the *home* market shouldn't use the narrower island; NAB is for broadcasters."

Performance specifications of the new standard will be examined next month. Æ

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Forum on microphones & headphones

ART SALSBERG

Microphones and headphones are obscure components to many high-fidelity enthusiasts. As with other transducers, there just aren't enough meaningful, standard measurements available to allow judgements to be made by simply reading a spec sheet. You have to *listen*, and therein lies the problem. Personal tastes are involved and, because relatively few people enjoy much experience with either microphones or headphones, these tastes have not been refined to the point where proper evaluations can be made.

We turned to manufacturers of microphones and headphones for answers to some of the more pressing questions of readers, judging from letters mailed to AUDIO over a period of time. Manufacturers' answers might serve as an excellent guide to prospective buyers of these components.

microphones

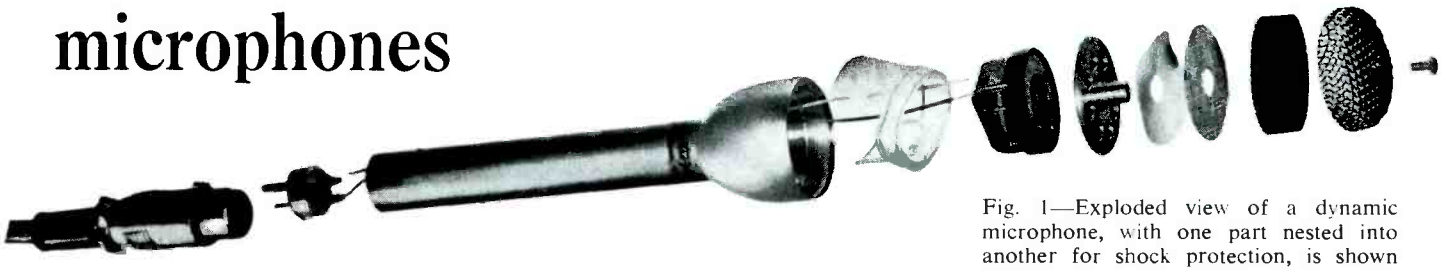

Fig. 1—Exploded view of a dynamic microphone, with one part nested into another for shock protection, is shown here.

A general impression exists that there's one microphone type that can serve well under all circumstances. Unhappily, this is not true. The ne plus ultra, all-purpose microphone does *not* exist.

We could not expect a single microphone to combine *all* these attributes, for example: high-output level and low-output level, compact size and ability to operate under water, unidirectional and omnidirectional characteristics.

The general types of microphones available—crystal or ceramic, dynamic, ribbon, and condenser—need not be discussed here. These have been covered in the past, as recently as the June issue of AUDIO (*Fundamentals of Audio*). But other facets require exploring. For example, what are the important specifications of a microphone?

Specifications

Most manufacturers agree that the following microphone specifications are most important to prospective buyers: (1) frequency response, (2) polar pattern, (3) impedance, (4) output level. In addition to the foregoing, sensitivity to hum, pop, wind, and shock; ruggedness; weight; size; and accessories were mentioned by some manufacturers.

It is interesting to note that not a single manufacturer indicated that distortion is an important specification, no doubt because rating standards have not been established and distortion specs are, as with other transducers, not a subject for braggadocio.

Let's examine each specification in its turn.

1. **Frequency Response.** Though all manufacturers numbered frequency response at or near the top of the list, some attached more stringent specs to it than others.

Paul Franklin of *Electro-Voice*, for example, emphasized the importance of uniformity of response, that is, a tolerance of, say, ± 2 dB, as opposed to a frequency response that does not indicate deviations. In addition, Franklin included response shaping in his spec list: Is the response flat overall? Does it have rising bass? etc.

Elpa Marketing, distributor of Beyer microphones, notes that, while a 100 Hz to 5,000 Hz response is broad enough to reproduce a human voice with clarity, a wider response will give a more natural sound (but will also increase background noise).

William Phillips of *Dynaco*, distributor of B&O microphones, observes: "Often the advertised frequency response does not define limits and, therefore, may bear little correlation with the performance quality." This is in line with Electro-Voice's comment on response uniformity. Phillips advises, "Try to see a response curve—unretouched, not a smooth, 'average' curve—and ask for the method by which the tests were made." This is easier said than done, of course. In Europe there is a DIN standard by which all mikes are tested, so comparison is relatively easy. In Amer-

(Continued on page 22)

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stereo headphones

WHERE HEADPHONES WERE ONCE LIMITED in sales to a small circle of non-professionals—serious tape recordists, binaural sound experimenters, and kids with crystal radio sets—everyone who owns a hi-fi stereo music system today is a prime prospect for them. Burgeoning stereo headphone sales attest to this. Yet laymen know less about headphone characteristics than any other hi-fi component.

You can blame this on lots of reasons: absence of accepted standards of measurement, measurement problems associated with transducers, and the need to use an artificial model to substitute for a human being during many tests.

AUDIO examines these hurdles to meaningful information about stereo headphones by discussing them with leading headphone manufacturers.

How Does a "Miniature Speaker" Produce Wide-Range Sound?

Richard H. Campbell, *David Clark Co.*, says, "A miniature speaker is in the best possible position to produce a wide sound range provided the acoustic impedance that it looks into is properly controlled at low frequencies. If the characteristics of a piston are maintained," he notes, "then there is no theoretical limit to low-frequency response. At high frequencies, a miniature speaker does not have any wavelength/geometry problems until, perhaps, 3 kHz to 5 kHz. An earphone is therefore capable of exceedingly wide-response," he concludes, "without crossover or dual elements. And moreover, this range is within a linear, resonant-free region of the driver geometry."

John Koss, president of *Koss Electronics,* compares headphones with speakers. Noting that headphone reproducers are placed close to the user's head in specially-designed cups, he observes, ". . . creates a very heavy damping which cuts down the normal resonant effect to such a point that extremely-low frequencies can be reproduced. This damping cannot be obtained in a speaker system and, consequently, the speaker system is very ineffective below its resonant point. . . . There are no room or cabinet resonances, or reflections from walls, ceilings or furniture."

Charles Hohmann, *Jensen Manufacturing* engineer, considers the miniature loudspeaker used in a headphone as a first approximation of a rigid piston working into a rigid, perfectly-sealed volume of air. "Under these theoretical conditions," he says, "the output response would be uniform from any chosen low frequency upward to near resonance. At resonance the output would rise to a peak and then drop off at a rate of 12 dB per octave above resonance. Under actual operating conditions, however, the speaker diaphragm is not a rigid piston, the walls of the enclosed volume of air are not rigid, and there is not a perfect seal between the diaphragm and the air volume.

"Under these conditions, the response does drop off at low frequencies. The response usually rises rather smoothly up to resonance, usually between 200 Hz and 1000 Hz, and then drops off with a rather rough response

(Continued on page 24)

microphones

(Continued from page 20)

ica, however, there is no accepted standard and, therefore, comparisons are difficult.

A frequency response curve is shown in *Fig.* 2.

2. Polar Pattern. Variously called pickup pattern, field pattern, polar response and directional response, as well as polar pattern, this key measurement reveals the sensitivity of a microphone in relation to frequency response in a field of 360° A polar pattern reveals off-axis sensitivity in all directions, thus defining its basic pickup pattern (cardioid, omnidirectional, bidirectional) in an easy-to-visualize manner. See *Fig.* 3.

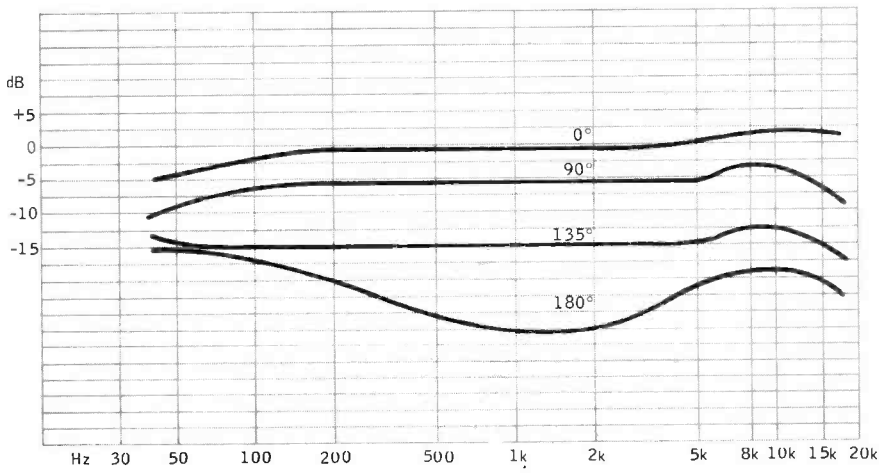


Fig. 2—Frequency response curve taken on-axis and off axes.

The directional characteristics of a microphone are doubtlessly of paramount importance to a user. A cardioid microphone field pattern is certainly the most popular choice among amateur recordists. This is the heart-shaped pickup pattern that receives sound in "one direction," excluding sound at its rear, as shown in *Fig.* 4. A bidirectional mike is sensitive to sounds coming from front and back, not sides. An omnidirectional pattern indicates that sound is picked up equally well from all directions. This mike is often included with a tape recorder. It's widely damned by many home recordists—but for the wrong reasons. Contrary to popular beliefs, the omnidirectional mike is, indeed, useful, though the cardioid make is probably *more* effective in the hands of amateur recordists. The mike often included in the purchase of a tape recorder can be faulted due to its poor frequency or limitations of its high impedance, but not for its pickup-pattern category.

This view is reinforced by microphone manufacturers. For example, *Gotham Audio's* Steve Temmer, who distributes Neumann microphones, says, "Cardioid is the most popular but . . . Figure-8 and omnidirectional patterns have very important roles and are often neglected."

Paul Franklin, *Electro-Voice*, notes: A cardioid is the preferred choice for use by non-professionals in most applications, yet hand-held, pass-around interviews, or other 'close mike' situations can be covered very well by a good omnidirectional unit." However, he observes, "The use of an omnidirectional microphone requires considerable experience and skill to achieve results comparable to a similar-quality cardioid."

Altec Lansing's William Hayes says, "The usage determines the type of microphone required. If one wants to sense everything, then an omnidirectional microphone is required. If one wants to discriminate against a certain "area of sound," say a noise crowd, but at the same time pick up the announcer, then a cardioid microphone is required."

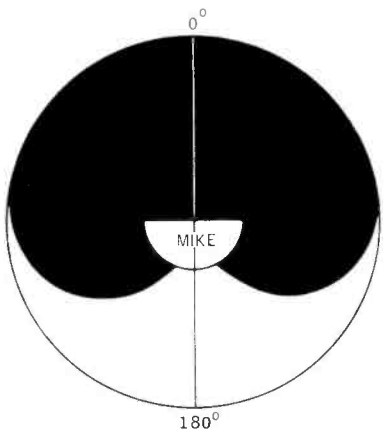
University Sound introduced a new element into the choice of microphone pattern. Cardioid types were chosen for their "front-to-back noise and reverberation characteristics plus unwanted signal discrimination."

Shure Brothers' Jim Kogen, too, advised that, ". . . wherever feedback is a problem, the unidirectional characteristic is desirable." He included the cardioid, hyper-cardioid, and super-cardioid patterns in this category. "The so-called line microphone, which is a highly directional device, is useful where there is a need to pick a signal out of a large area, such as pickup of signals from a quarterback on a football team or the sound of a marching band in the center of a large crowd. Bidirectional microphones," Kogen continued, "are useful in situations such as two people facing each other across a table. The omnidirectional microphone is used frequently in recording situations where feedback is not a problem: in paging systems . . ."

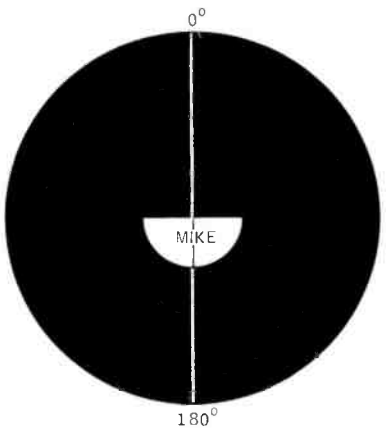
Horst Ankermann of Sennheiser,

(Continued on page 24)

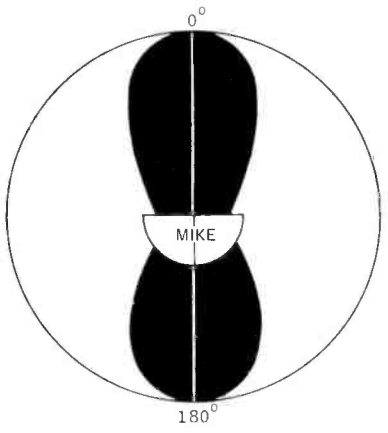
Fig. 3—Black areas indicate the sound-pickup pattern of each type of microphone.



UNIDIRECTIONAL
(Cardioid)



OMNIDIRECTIONAL



BIDIRECTIONAL

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MICROPHONES

(Continued from page 22)

opted for cardioid mikes where "rejection of background noise and reduction of feedback" is desirable, whereas omnidirectional microphones were indicated for use in ". . . interviews, round-table discussions, in acoustically-prepared rooms, stage performers." Ankermann, as did Kogen, took note of the use of narrow-beam acceptance —what Ankermann called shotgun mikes, by noting its use for "larger-than-normal recording distance in film and TV studios."

These views could be summed up by *Dynaco's* William Phillips, who said, "The best mike pattern depends entirely on the particular recording situation. This is why anybody actively interested in recording as a hobby or as a semi-professional will have several mikes on hand . . ."

Both Kogen of *Shure* and Phillips of *Dynaco* emphasized the need for detailed pickup patterns. Kogen stated that polar responses should be given at all frequencies and in three dimensions, noting that the response should be symmetrical and consistent. Phillips pointed out that an even polar response is particularly important in stereo recordings in order to maintain the proper spatial relationship.

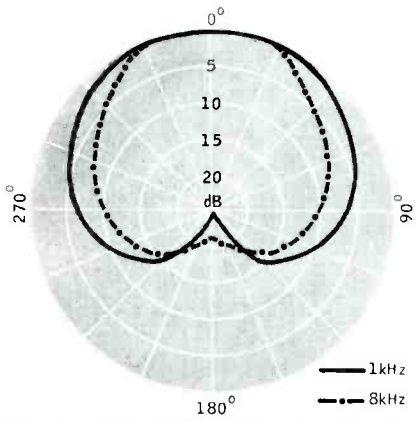


Fig. 4—Polar response curve of a cardioid microphone gives clear picture of mike's pickup pattern with different frequencies.

If you're wondering how to perform a polar response test on your microphone, follow Electro-Voice's example, if you can: (1) Find a carefully-designed anechoic chamber. (2) In the chamber, rotate your microphone through 360° at four feet from a sound source generating a constant output. (3) Take measurements at several frequencies with accurate, calibrated instruments.

Continued next month

HEADPHONES

(Continued from page 21)

above resonance. The high-frequency output is produced by the diaphragm vibrating in models rather than as a rigid piston, producing output appreciably greater than the expected 12 dB per-octave rate of output reduction."

Sharpe Instruments directs our attention to a technical paper which appeared in the Journal of the Acoustical Society of *Acoustics of Circumaural Earphones*. In discussing the addition of an electro-acoustic transducer to a circumaural ear defender, the authors note, in an experimental earphone, ". . . above 500 Hz the driver unit response falls steadily with increasing frequency while the earphone over-all response is virtually independent of frequency. Thus it would appear that the diminution of driver-unit sensitivity with increasing frequency is exactly compensated by a variation with frequency in the coupling impedance of the circumaural enclosure. . . ."

"Wide-range sound is due to the greatly-reduced moving mass, greatly-reduced air volume, and greatly-reduced excursions needed for a given sound pressure level," sums up Steve Temmer, *Gotham Audio*.

Bass Response

In discussing precautions needed to assure good bass response, it is important to ignore problems facing speaker systems. Whereas speaker systems must push considerable air into a room to achieve significant low-frequency response, headphones only contend with a very small volume.

Manufacturers are in full agreement that, to assure good bass response, headphones must be tightly coupled to the user's head so that there is as little air leakage as possible. Other considerations in achieving good bass response include selection of driver and housing, the latter relating to air volume. All things being equal, a smaller air volume produces better bass response.

The need for tight coupling has given rise to a variety of earphone cushions that combine excellent ear seals without reducing comfort. Early headphones used foam-rubber ear cushions, later covered with washable vinyl. Fluid-filled cushions have been found to provide especially-tight coupling and many headphones employ this type seal today.

The headband, which is usually adjustable, plays no direct role in headphone performance. However, it allows for proper positioning of individual phones to assure a good seal to listeners' ears. Aside from this, its basic role is to provide a degree of comfort.

Headphone Impedances

Is the actual impedance of headphones important to users? It seems not, according to headphone manufacturers. With so little power required to drive headphones, efficient transfer of power is not an important criterion, it seems.

Headphones are frequently connected to the output of an amplifier through a resistor in series with the phones or a transformer to attenuate output. This is desirable because so little power is required to drive the phones to a listenable level. John *Koss* points out, "To produce the same volume level in the ears with a speaker system, nearly a thousand times as much power would be needed."

Owners of late-model amplifiers won't experience any difficulty here. Most of today's receivers, integrated amplifiers, preamplifiers, and modular systems incorporate a headphone jack, generally on the front panel. Simply plug the headphone set in; resistors to decrease phone sensitivity are already incorporated into the electronic equipment.

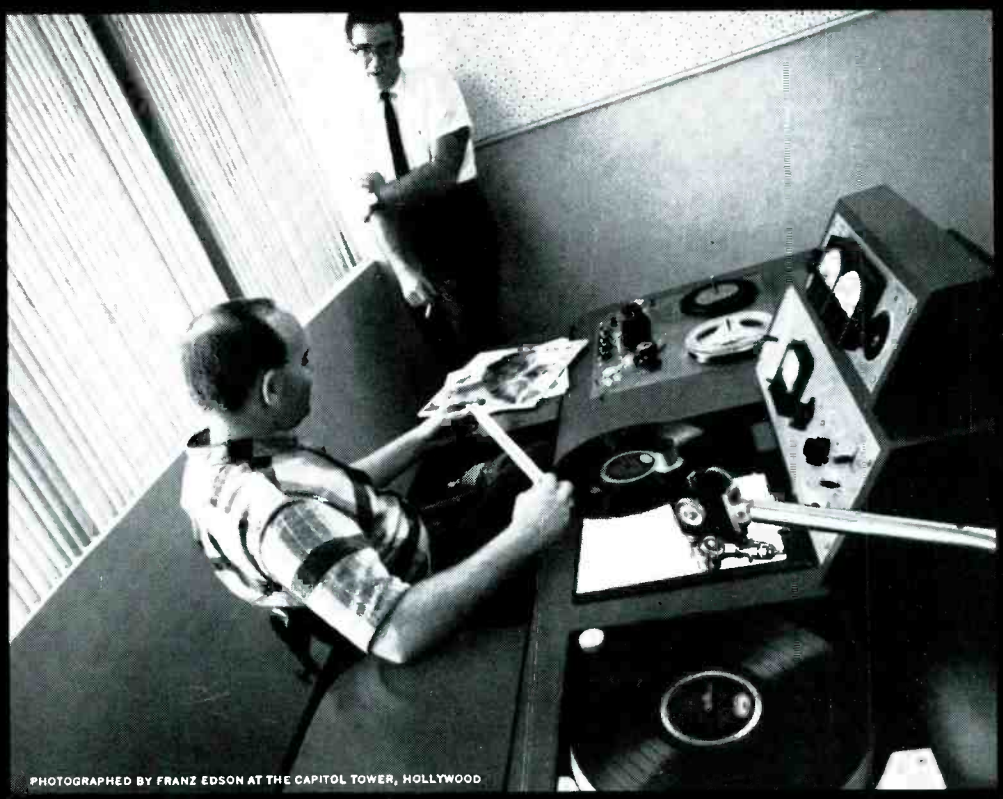
Richard Campbell, *David Clark*, comments that earphones "between 8 and 50 Ohms will give satisfactory performance plugged into this jack. A 300-Ohm (per side) earphone will operate very nicely directly on the speaker terminals," he observes, "allowing the use of a stereo speaker cut-out. An 8-Ohm phone wired directly to the loudspeaker taps will," he cautions, "pick up amplifier hum and noise . . . be blown up."

There are instances where impedance matching *is* important. For example, Hohmann of *Jensen* advises that headphones should match the specified impedance of the networks of the company's headphone control centers to assure proper operation. (A resistor does the job where impedances do not match.)

Steve Temmer, *Gotham Audio*, notes that impedance values become important if used in certain professional equipment designed especially for specific headphone operation. He gives the Nagra tape recorder as an example. So does Ankermann, *Sennheiser*.

Continued next month

When engineers get together, the conversation turns to pickups.



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STANTON

Audio Measurements Course

Part 17 (Conclusion)

NORMAN CROWHURST

Guidelines to connecting speakers in a variety of ways are explored here. Impedance, phase, amplifier-loading measurements under different speaker connection conditions are illustrated, as well as how to tailor crossover networks for desired results.

IN DISCUSSING MEASUREMENTS relating to more sophisticated circuits, one can easily overlook some apparently simpler things. Many letters from readers relate to these. A couple of installments back we discussed measurements relating to speaker impedance, but developed them for the specific purpose of working on a bass-reflex cabinet. Another area often questioned relates to various ways of connecting multiple speakers.

Theory and Practice Sometimes Differ

We have both written and read articles discussing the theory of different methods of connection, simple series or parallel, various crossovers and so forth. Too often connections are finally made solely on the basis of such theorizing and the results do not turn out to be all one might expect from the theory!

If you plan any speaker interconnection at all, whether simple series/parallel or a crossover arrangement, beyond just a "lash-up" to have the units operating in the same circuit, the impedance characteristics should be checked.

Series Connection

For example, if you contemplate series connection of speakers in different rooms, how do the impedance characteristics of the units compare? If they are similar (*Fig.* 17-1), the total impedance will be of similar form and the power distribution will not be far from uniform.

But if they are different—particularly if their resonances are radically different—then although the series connection may result in less impedance variation as a load for the amplifier than does either unit individually, or than two identical units so connected, the power distribution will be poor and have a noticeable effect on the sound from each unit (*Fig.* 17-2).

Impedance Runs

Whether this is likely to happen can easily be found by simply making an impedance run on each unit. The simple way to do it is to feed the unit through a fairly high resistance—say 1000 ohms—and observe the pattern on an oscilloscope. Calibrate the scope by connecting vertical and horizontal inputs in parallel and setting deflection to be equal each way, to make a 45-deg. line trace.

Then connect the speaker and cut out some of the 'scope's decade attentuation, until the vertical deflection is of the same (readable) order. If you cut out 1 decade of attenuation, and the deflection is then 4/10 of the equal deflection set up in the calibration (*Fig.* 17-3), the voltage across the voice coil is 4/100 of the input voltage, or the impedance is 40 ohms at this frequency.

To obtain the complete impedance characteristic, first make sure the speaker is operating sensibly in its normal manner—i.e., don't lay it with the cone facing down onto the bench, or toward a wall, but have it in a position similar to that in which it normally "plays."

Now take readings at strategic frequencies. First spot the maxima and minima, by taking readings where the loop closes to a straight line (as detailed in installment 15). Then take readings where the ellipse is at its widest, or most open, to find the position of approximate mid-points on the ups and downs, and also take extra points towards the high end, where there are no more resonances that show up electrically.

Determining Phase

Several references have been made to determining phase from the elliptical trace of an oscilloscope. A few tips help in making an accurate assessment of phase angle, where a good measurement is possible. The easiest angles to read belong to traces where vertical deflection equals horizonal, as in *Fig.* 17-4, (A) and (C). But the method of reading magnitude and

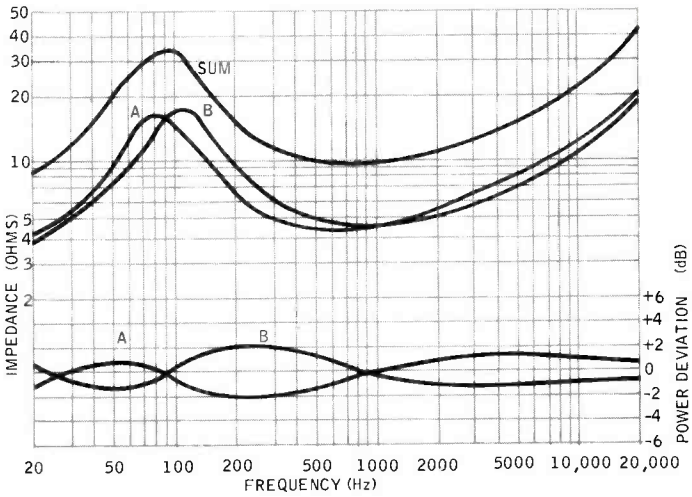


Fig. 17-1. Impedance characteristics of two similar speaker units connected in series. At top is shown the individual impedance curves and their sum. Below is shown the variation in power division between them, due to Z difference.

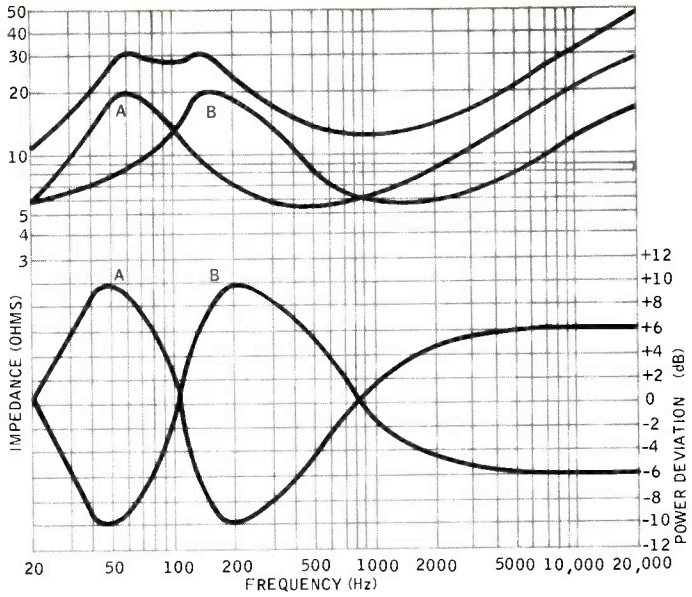


Fig. 17-2. The same thing for two dissimilar speaker units. The diversity of impedance holds the total to smaller variation, but the variation in power division at different frequencies is far greater.

phase at once, without disturbing the 'scope calibration for magnitude, make it more convenient to use ellipses where height is sometimes not equal to width, as in (*Fig.* 17-4, (B) and (D).

We show, as examples, two traces representing an angle of 30 deg. and two representing an angle of 60 deg. These are chosen because the sine and cosine, respectively, of these angles is precisely 0.5. Sines and cosines of other angles can be read from trig tables or, conversely, the angles found when the sine or cosine values have been obtained from the trace.

For angles less than 45 deg., such as 30 deg., it is best to use the ellipse's intercepts on the axes. See *Fig.* 17-4, (A) and (B). These, expressed as a fraction of the maximum deflection in each direction, will give the sine of the angle. Note that when vertical deflection is not equal to horizontal, the units for comparison are different.

For angles more than 45 deg., such as 60 deg. it is best to use the points where the ellipse is tangential to its boundaries, as in (C) and (D) of *Fig.* 17-4. These measurements, expressed as a fraction of the maximum deflection in each direction, give the cosine of the angle.

To get a reliable reading, adjust the trace in position on the graticule so that all relevant maximum deflections, from center, as well as the intercepts or tangent points, can be read off. They should be close to equal, and if they are not exactly equal, average values should be taken to calculate the angle.

A Different Kind of Speaker Distortion

At lower frequencies, even at the low level permitted into the unit by the 1000-ohm series resistor, which will only be in milliwatts, distortion may show up by the ellipse going seriously out of shape (*Fig.* 17-5). This distortion may be due to reflection of acoustic effects, but at this level it is more likely to be due to hysteresis effects in the pole pieces adjacent to the voice coil.

An important factor to bear in mind here is that the current is held sinusoidal and the voltage measured across the coil is non-sinusoidal. In normal operation, voltage will be nearer sinusoidal, allowing current to become non-sinusoidal. But the important thing is, how does the motion of the cone relate to voice-coil voltage and current at these frequencies?

This can be measured in the manner discussed under acoustic measurements, and related to the manner of feeding the speaker voice coil: high damping factor, approximating constant (sinusoidal) voltage, or low

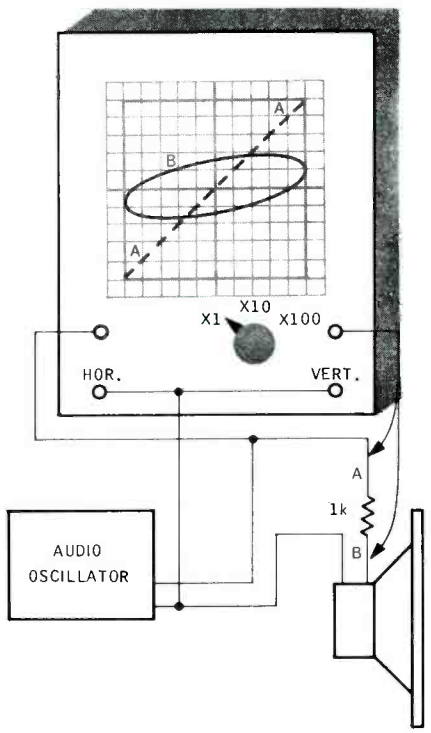


Fig. 17-3. How to measure the impedance characteristic of a speaker unit with an audio oscillator and 'scope.

damping factor (series resistance used) approximating constant (sinusoidal) current.

The distortion between voltage and current can be estimated as shown in *Fig.* 17-6. A phase shift is inserted in the horizontal, which contains pure fundamental, until the trace is what would be a straight line, if there were no distortion. This can be determined by adjusting the phase-shift resistor and corresponding horizontal deflection (to maintain width of trace) until the trace lies between two parallel sloping lines.

The spacing (measured vertically) between these sloping lines, as a fraction of their height over the horizontal deflection used, which will be approximately the same as maximum vertical deflection, gives the distortion (times 100 for a percentage figure). If desired, a more sophisticated bridge-type circuit can remove fundamental from the vertical deflection, to enable more precise measurement of the distortion component.

It should be noted that a low damping factor can thus cause distortion due to magnetic characteristics of the speaker magnet assembly, a fact not always appreciated. The measurements of *Fig.* 17-6 show this relationship directly, irrespective of electro-acoustic performance. It can also be shown indirectly by comparative acoustic measurements, using different damping factors.

This distortion should not be confused with non-linear transfer from electrical to acoustical energy, due to magneto-electric effects of the motor coil, which becomes more evident when larger powers are used at low frequency, related to non-linear distribution of magnetic flux in the gap. This form of distortion can only be measured acoustically.

The top-end frequencies can also be important in impedance characteristics because the inductive component of different speaker units varies. When you have all the data on a particular speaker, plot the curve (*Fig.* 17-7). Following is the data on which this curve was based. The speaker was rated at 8 ohms, and designated a woofer.

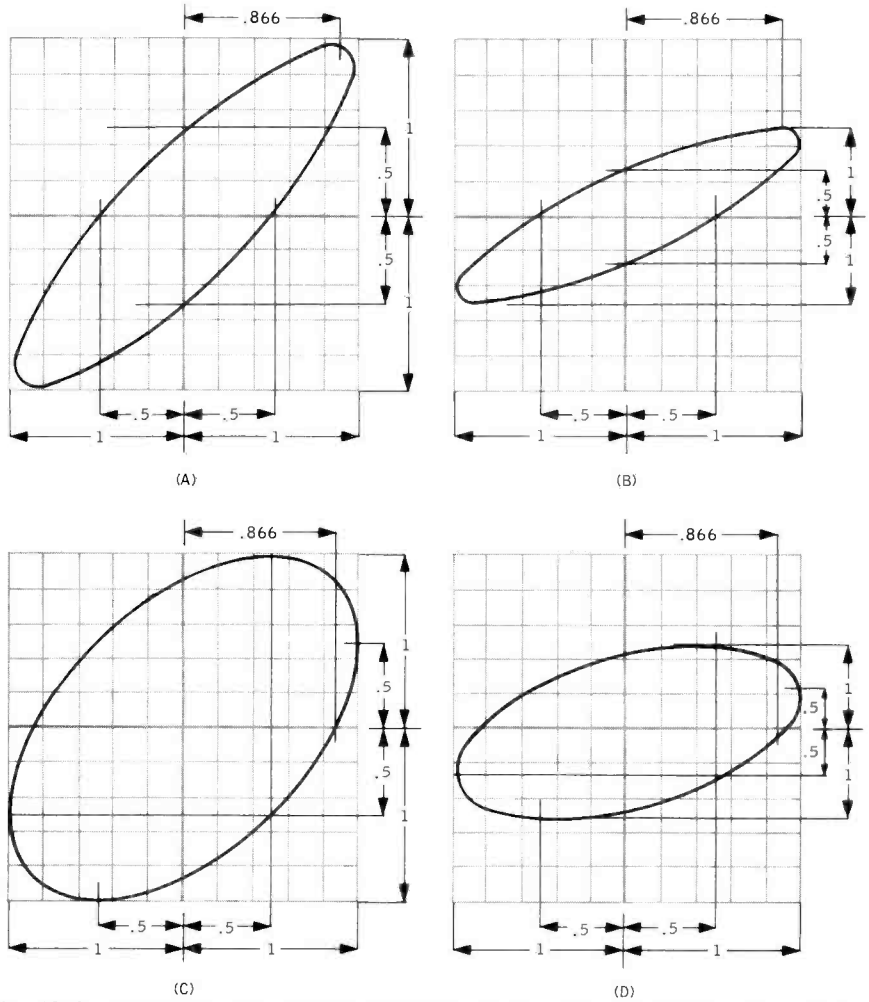


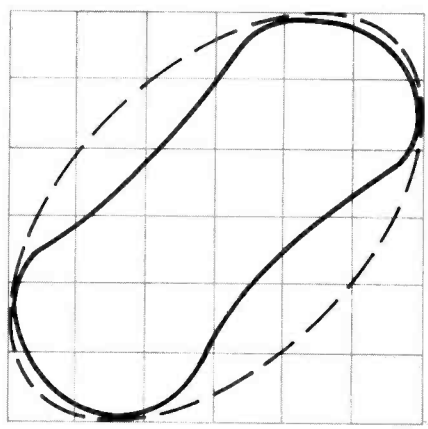
Fig. 17-4. Interpreting the ellipses obtained to give the impedance value phase. The top two traces each represent a phase of 30° and the bottom two one of 60°.

Examining these results shows that small fluctuations are occurring above 1000 Hz, due to reflected radiation effects. The waveform went bad for frequencies appreciably below 66 Hz, invalidating attempts to measure phase by this method. But for determining how to design a crossover, this information is useful.

Amplifier Loading

Before proceeding, we should consider the possibility that the amplifier is incorrectly loaded at some frequencies if not throughout the range, and therefore some distortion may result. Measure frequency response and distortion when the load departs from

Fig. 17-5. At low frequencies the ellipses may not be of good enough shape to estimate phase (solid line). Causes for this are discussed in the text.



Frequency Hz	Z Impedance Ohms	ϕ Phase Degrees	Resistance Component (Z cos ϕ) Ohms	Reactance Component (Z sin ϕ) Ohms	Equivalent Inductance MicroHenries
66	10	40	7.6	6.4	Motional
88	16	0	16	0	Impedance
120	10	20	9.4	3.4	at these
340	6.5	0	6.5	0	Frequencies
1000	7	18	6.6	2.16	340
2000	9	25	8.1	3.8	300
2500	8.5	25	7.7	3.6	230
3000	9	27	8	4.1	220
4000	10	30	8.6	4.3	170

Several interesting facts about the design of the new Dual 1015: after you read them, you may wonder why other automatic turntables aren't made this way.

You've probably noticed that many of the new automatic turntables, in several price ranges, offer features like anti-skating devices, levers for raising and lowering the tonearm (cueing devices), interesting motors of one kind or another, plus some pretty fancy designs for overall appearance.

Well, the new Dual 1015 has these things too. Even the fancy design for overall appearance.

But our features are different. Different because we don't offer them just to offer them. They are there to perform a real function. With precision and accuracy.

Take our anti-skating control.

It's there because, quite simply, our low-mass tonearm skates. No, that isn't something to be ashamed of. In fact, it indicates bearing friction so low (less than 40 milligrams, always) that there's no internal resistance to skating. Even at ½-gram. (You'll note that other arms offering anti-skating devices don't mention bearing friction. It's understandable. If bearing friction is high, skating never occurs in the first place.)

And that's not all.

Our anti-skating control is continuously variable and dead-accurate. It doesn't under-compensate or over-compensate. This means the stylus will track with equal force on both walls of the stereo groove. Also, our anti-skating control applies force internally, at the pivot, keeping the force constant throughout the record. You can't do this by applying a dead weight to the outside of the arm.

Okay, now for our cueing control.

The purpose of cueing is to lower a stylus to a predetermined spot on a record. Accurately and gently. If it does neither, or just one of these things, it's not cueing. It's simply doing what you could do by hand (that includes damaging a high-compliance stylus).

Dual's cue-control is accurate and gentle. Rate of descent is .5cm/second and is controlled by silicon damping and piston action (which also prevent side-thrust from anti-skating). And the cue-control works on automatic as well as manual start.

Here are a few more things that should interest you:

Our hi-torque motor is a constant speed motor. It's quieter and more powerful than a synchronous motor, and turns the record accurately. Not just itself. (It maintains record speed within 0.1% even if voltage varies ±10%.) Our counterbalance has practically no overhang (for compactness), and locks in position to prevent accidental shifting.

By the way, about that fancy design for overall appearance:

We know that a lot of you wouldn't even consider a top, precision product if it didn't look good.

With all that precision, and a price of only $89.50, the Dual 1015 gets better looking all the time.

United Audio Products, Inc., 535 Madison Ave., New York, N.Y. 10022. Dual 1015

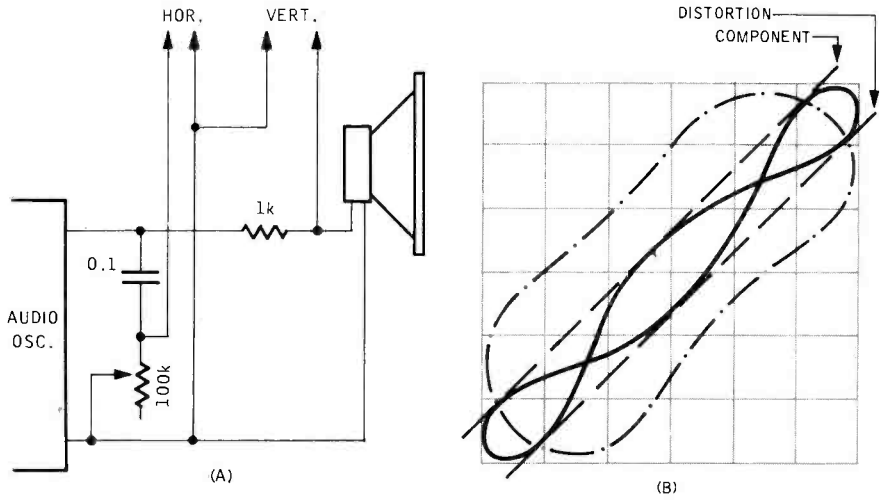


Fig. 17-6. How to phase-shift the trace of Fig. 17-5 so that its distortion component can be evaluated.

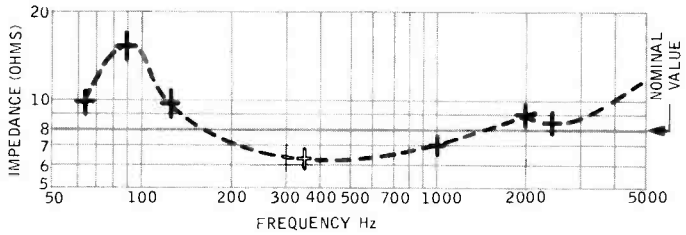


Fig. 17-7. The impedance curve (values given in table in text) plotted out.

nominal (*Fig.* 17-8).

Just changing the resistance load may alter frequency response and/or distortion. But actual loading of the kind just measured is apt to introduce reactance elements as well as incorrect resistance values.

Simulating Speaker Load

From the impedance characteristic measured, the minimum impedance is 6.5 ohms (at 340 Hz). The acoustic resonance adds about 9.5 ohms at 88 Hz. At 66 Hz, the capacitance element will be 4/3 times, and the inductance ¾ times their reactance values at 88 Hz, so the resultant shunt reactance at 66 Hz will be 12/7 times the reactance value each has at 88 Hz. At 120 Hz a similar relation holds, except that the inductance causing the rise at higher frequencies is beginning to have effect and will change matters slightly.

The reactance at 66 Hz is 64 Ohms, so the reactance of both capacitor and inductor elements at 88 Hz must each be 3.75 ohms. A reactance chart gives these values as 6.8 milliHenry and 480 microFarad. An electrolytic of 500 mfd with an inductor of 6.5 milliHenry will about do for simulating this. If the dynamic impedance, measured with the 'scope at 88 Hz, is more than 9.5 ohms (for which the Q at 88 Hz would need to be better than $9.5/3.75 = 2.5$) then a resistor should shunt it down to 9.5 ohms.

Now to simulate the upper-end impedances, without any crossover: at 1000 Hz, the series resistance has not risen appreciably, and the reactance represents about 340 μH. As its value is falling, it may be simulated by, say, 400 μH with a shunt resistor, *Fig.* 17-9. At 4000 Hz, the inductance has halved, and about 2 Ohms have been added to the series resistance component.

This combination suggests a resistance of about 8 to 10 Ohms (it won't simulate exactly, because of the fluctuations). Make up this bunch of components and see how closely it simulates the desired impedance by connecting it in place of the voice coil in *Fig.* 17-3. It will probably be close enough to find out how it affects amplifier performance.

Measurement of amplifier performance into a practical load should be made with such simulated impedance, rather than actual speaker loads, because speaker impedances can be nonlinear at working levels, even though they looked good on the low-level impedance test. The inductors and capacitors used in the simulated impedance should be capable of handling the levels used for test without appreciable distortion, and the resistors must be capable of dissipating the power.

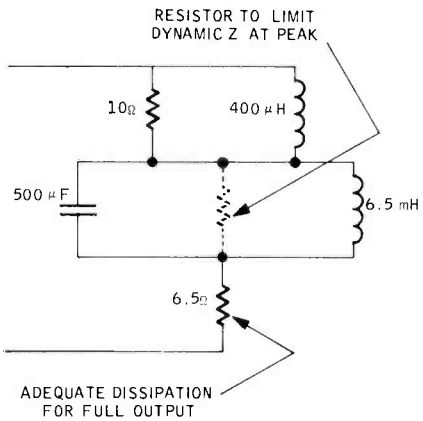


Fig. 17-9. A simulated impedance made up to approximate most of the features in the curve of Fig. 17-7.

The speaker itself can reflect distortion that may not be due to the amplifier directly. If voice-coil excursion exceeds linear response movement at some frequency, the reflected motional impedance may be nonlinear and thus will introduce distortion components in measured voltage or current. Using passive, non-distorting elements avoids the possibility.

This does not say that speaker distortion should not be measured. But you have to be sure that the amplifier is not causing the distortion because it "doesn't like" the particular reactance combination presented by the speaker. Then, when you substitute a

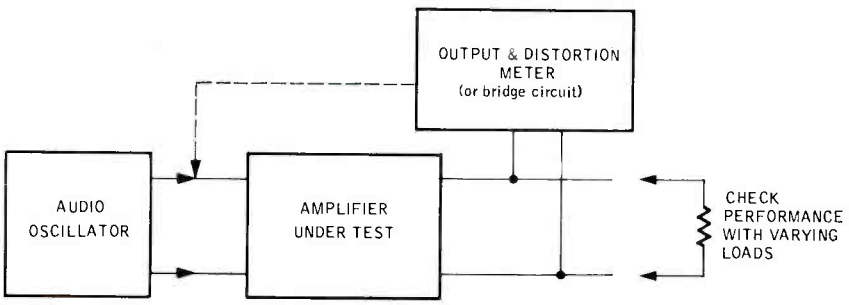
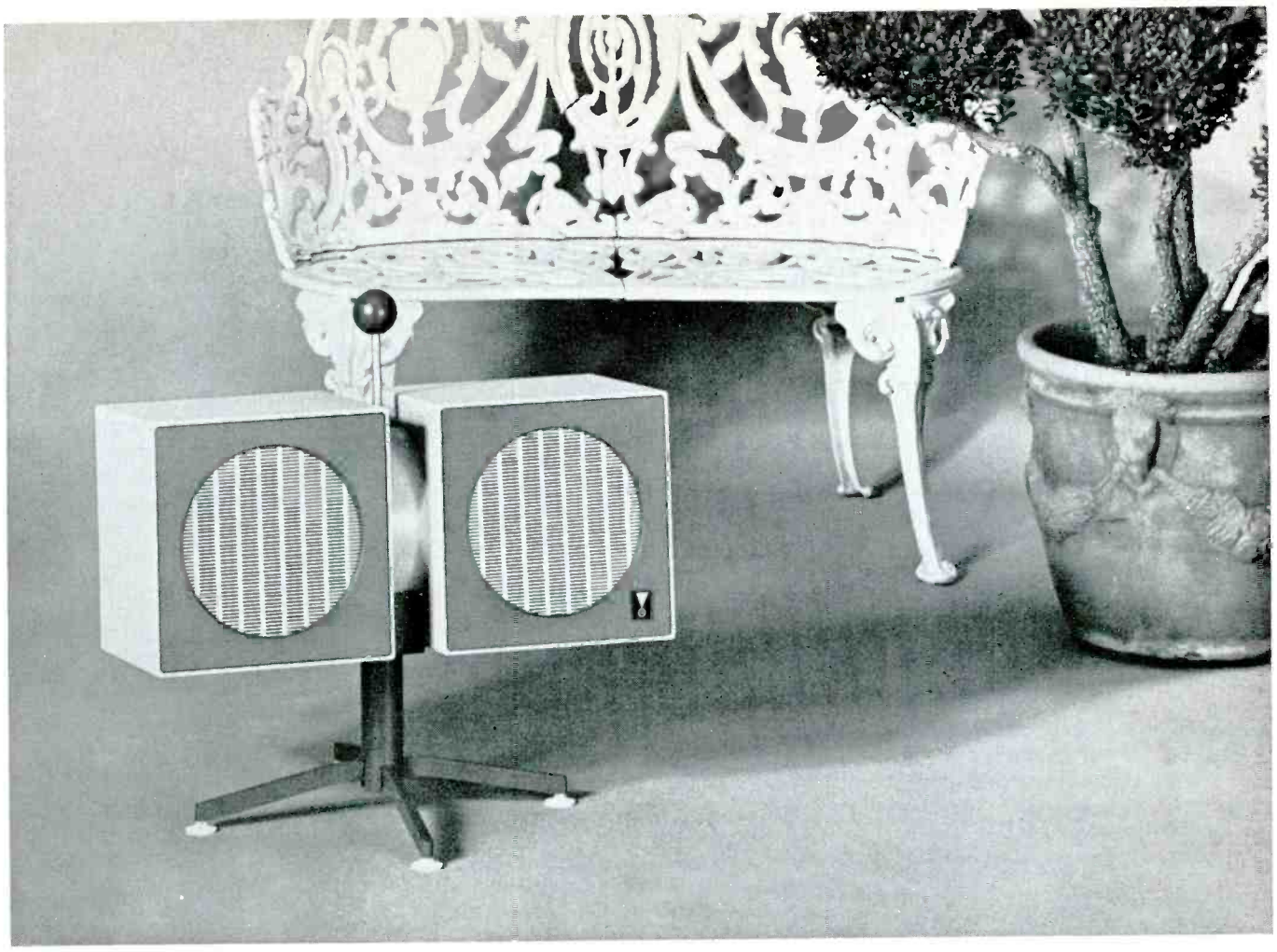


Fig. 17-8. Check amplifier response and distortion with various output loads, as well as the nominal one.



For the first time...

Full-Range, Full-Fidelity Sound Indoors or Outdoors with the JBL FESTIVAL!

Until the introduction of the JBL Festival, the high fidelity listener had to be content with compromised sound for outdoor applications.

No further compromise is necessary. JBL has taken the famous LE8T and PR8 (so popular in JBL's Lancer 44 and Trimline 54 indoor systems) and has housed them in a decorator enclosure of tremendous flexibility. The JBL Festival is totally portable, water-resistant, and delivers the full spectrum of sound to patio, porch, pool-side, or lawn. It can be tilted to face the optimum area of sound coverage and locked with a twist of its convenient carrying handle. It can even be mounted to eaves or ceiling beams by using the hangers supplied.

The JBL LE8T is undoubtedly the world's finest full-range transducer, a 6½ pound magnetic assembly, larger and more powerful than those used in most 15-inch loudspeakers...a highly sophisticated suspension for linear cone travel up to ½-inch...an exclusive pure silver impedance-controlling ring that increases the speaker's efficiency more than fourfold in the 20,000 cps region...JBL precision tolerances and hand craftsmanship throughout.

JBL's PR8 Passive Radiator effectively doubles the LE8T's bass radiating area to deliver solid low frequency fundamentals, even out of doors where bass tends to "fade". At the same time, the PR8 maintains the sealed, weather-proof character of the L59 enclosure.

JBL

The JBL Festival is a superb loudspeaker system for indoor use. It is the only loudspeaker system designed to deliver full-range fidelity outdoors as well!

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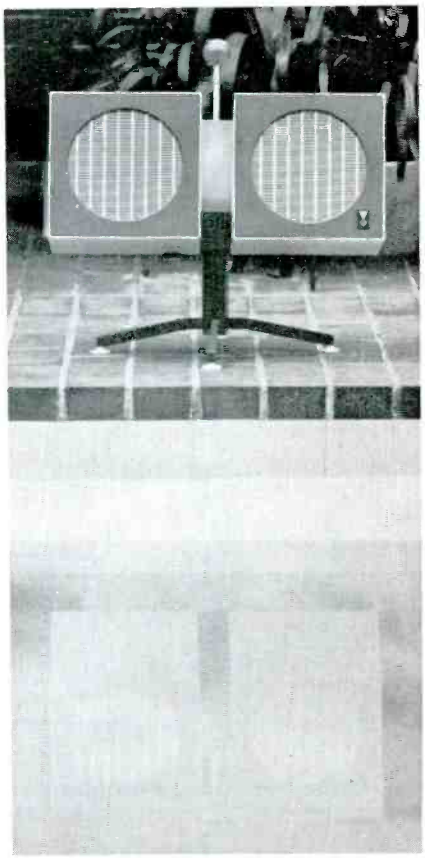

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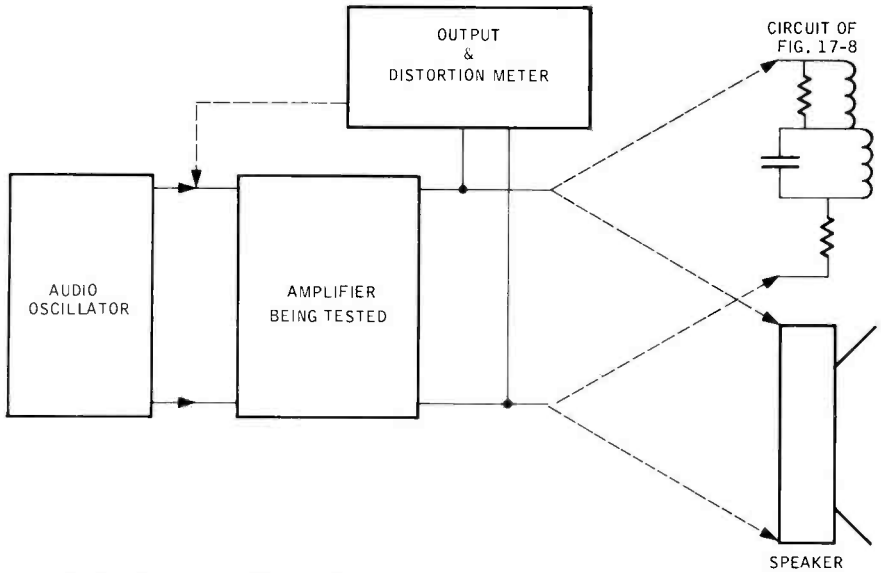


Fig. 17-10. Check amplifier performance into both simulated load and the speaker unit it represents. This will detect distortion components reflected by speaker.

speaker whose impedance characteristic has been simulated electrically, and have proved that the amplifier doesn't distort with that kind of a load, any increase of distortion that then appears must be in the speaker (*Fig.* 17-10).

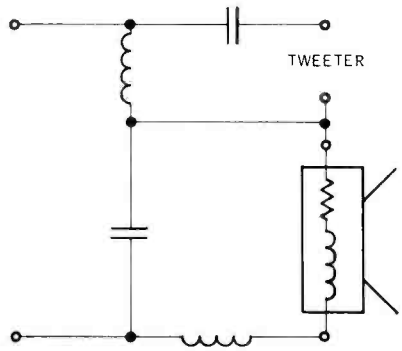
Tailoring a Crossover

Now assume we wish to put together a crossover, with actual speakers for termination, instead of the idealized resistors. As all dynamic speakers have an inductive impedance toward their high-frequency end, it is useful to pick a crossover design that uses an inductive element in the feed to the low- or mid-frequency unit. The effective inductance of the speaker can be used as part of the filter. (*Fig.* 17-11).

First step now is to decide on a crossover frequency and how sharp the roll-off should be, as well as what impedance to use. The impedance curve (Fig. 17-7) suggests 8 ohms as nearest standard. Tweeters will have to be matched to this, somehow.

A test of the speaker's frequency response, either measured in an anechoic room, or listening to it critically as an oscillator is swept through the range, suggests that this woofer is "good to" about 2000 or 2500 Hz. As it does not "drop dead" suddenly, a medium slope crossover is desirable. Probably the best type to allow the use of voice-coil inductance as part of an element is the configuration of *Fig.* 17-12 (also *Fig.* 17-11, *d*).

A similar check on the intended tweeter's impedance shows that, although it is rated at 8 ohms, its impedance is about 4 ohms in the range of 2000 to 2500 Hz. For the matching to be correct, either two such tweeters are needed in series, which will decrease the sensitivity at higher frequencies, where the impedance of each



Fif. 17-12. The final choice for the job discussed in text. All reactances should be 0.707 times Z_o at crossover.

comes closer to 8 ohms, or the series capacitor of the crossover that feeds the tweeter needs changing to allow for this.

According to design data obtained from a handbook, each element in the configuration of *Fig.* 17-12 should have a reactance of 0.707 times the working impedance at crossover, which works out to 5.6 ohms. From this, the theoretical values for a crossover frequency of 2500 Hz would require two inductances, each of 360 μH, and two capacitors, each of 11.5 μF.

The woofer contributes about 230 μH at crossover frequency, so the output to the woofer needs only about a 120- to 150-μH inductor to make up the 360 total. The tweeter needs an additional reactance of about 4 to 5 ohms (its impedance is already slightly capacitance-reactive, otherwise a larger value would be needed) making up a total required capacitive reactance of 10 to 11 ohms, requiring a capacitor of 5 to 6 μF.

Set this whole thing up (*Fig.* 17-13), and check its impedance characteristic to see how well it matches throughout the range affected by crossover (about 500 to 8000 Hz). Also listen as the frequency is swept over

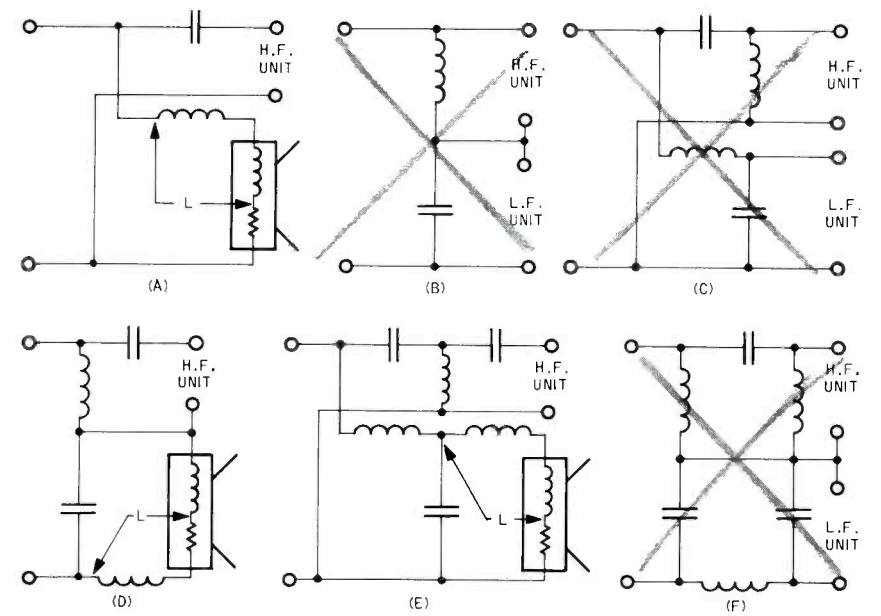
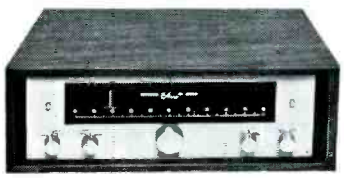


Fig. 17-11. Available constant-resistance crossover configurations up to 18 db/octave, showing the ones (a, d and e) that lend themselves to allowing for voice-coil inductance.

Marantz components are too good for most people.



Are you one of the exceptions? For the most astonishing set of specifications you've ever read, write "Exceptions," Marantz, Inc., 37-04 57th St., Woodside, New York 11377, Department A-17.

marantz
A SUBSIDIARY OF SUPERSCOPE, INC.

The Marantz components illustrated, top to bottom: SLT-12 Straight-Line Tracking Playback System • Model 15 solid-state 120-watt Stereo Power Amplifier • Model 7T solid-state Stereo Pre-amplifier Console • Model 10B Stereo FM Tuner

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AUDIO MEASUREMENTS

(Continued from page 32)

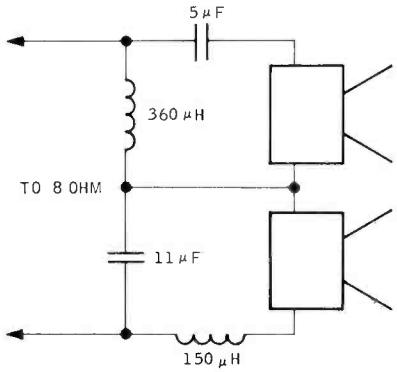


Fig. 17-13. Final values for use with the units measured for the job. Tweeter has a nominal value of 8 ohms, but actually is 4 ohms at 2500 Hz, and 8 ohms above 4000 Hz.

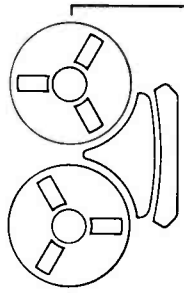
this range at a reasonable power level, or run a frequency response check in an anechoic room, if one is available.

We hope we have shown by this little bit of measurement, that designing a speaker system using crossovers is, at best, something of a compromise. As you listen or check under power conditions, you will probably find that there is not much audible difference, unless distortion occurs. The most that mismatch is likely to produce, of itself, is a dB or so variation.

But mismatch near crossover frequency can do more than this, by causing spurious resonance effects. This is why it is advisable to check out impedances in this range, and tailor the crossover quite specifically to do the job in hand. Readers have complained that they have adjusted component values (either on a bridge, or by building them up, assuming each has precisely its designated value, assuming such designated values are exact, rather than within stated tolerances!) to the second or third decimal place, only to find it doesn't sound as flat as they hoped.

What use is it to build up a 480 μF value with a 250 μF, two 100 μFs, 25 μF and 5 μF (which does add up) when the tolerance is given as −10 to + 15 per cent (earlier values were −20 to +30 per cent)? And electrolytics change with applied voltage, on a long-term basis.

Here is the reason for such readers' disappointment. They've been overly fussy with component values, to a theoretical ideal. All this underlines a motto that is always good, but perhaps especially so in audio: when in doubt, *measure*. Æ



Tape Guide

HERMAN BURSTEIN

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

Re-Hash

In the December 1966 issue of AUDIO there was a question as to the possible reason for the recording signal fading after 30 minutes or so of recording, and of the old material playing through. A reader, Lt. Col. Allen S. Webb, 240 Crestwood Drive, Sumter, S. C., has the following helpful comments. "I encountered the same problem with my tape recorder. I was told that the cause was the tape, and was told not to use a certain tape since it is abrasive and clogs heads. I changed my type and brand of tape, only to find that the trouble persisted. I decided to remove the head cover to see if I could detect anything unusual at the time fading occurred. To my surprise, I noted that after a period of time the pressure pad (which in the case of my machine is against the erase head only) was skewing the tape! Therefore the erasure of old material was partial or nil, and the tape could not be in proper alignment with the record head, although it was about right by the time it reached the playback head. I used a fine file to fluff the pressure pad and applied just a trace of baby powder. No further trouble! Of course I had a new pad installed at the first opportunity!"

Also in the December 1966 issue, there was a question concerning a variable low-pass filter for taping old and noisy records. My answer was to use treble cut to filter the noise, although this would, of course, remove some high frequencies as well. Reader Steve Keller, 1033 Oakland Rd. N.W., Cedar Rapids, Iowa, offers the following suggestion. "I believe that the audio buff was seeking information on a device known as a dynamic noise-suppressing amplifier, used several years ago, which is a gate circuit that will block noise by attenuating high frequencies when the signal is at low volume or contains only low frequencies. When high frequencies or high volume are present, the gate opens to give flat, wide-range response. The noise does not have to be filtered with this type of signal because the high volume or high frequencies will override the noise so that it is not noticeable.

"The practical effect of the suppressor is to improve the signal-to-noise ratio by 20 dB, without losing high-frequency content of the program. Several manufacturers used to make this equipment. I suggest that the reader send to these companies for information: H. H. Scott (Type 112-A Dynaural Converter); Fisher Radio Corp. (Model SAL Dynamic noise suppressor amplifier).

"He can also find information and schematics of all of the units listed above in the book, "High Fidelity Techniques," by John H. Newitt, Rinehart and Co., 1953. If he can't find this book he might try writing to the DeVry Technical Institute, 4141 Belmont Ave., Chicago 60641."

Q. I understand bulk tape erasers can be made from TV power transformers. If so, would you please inform me as to how to go about this.

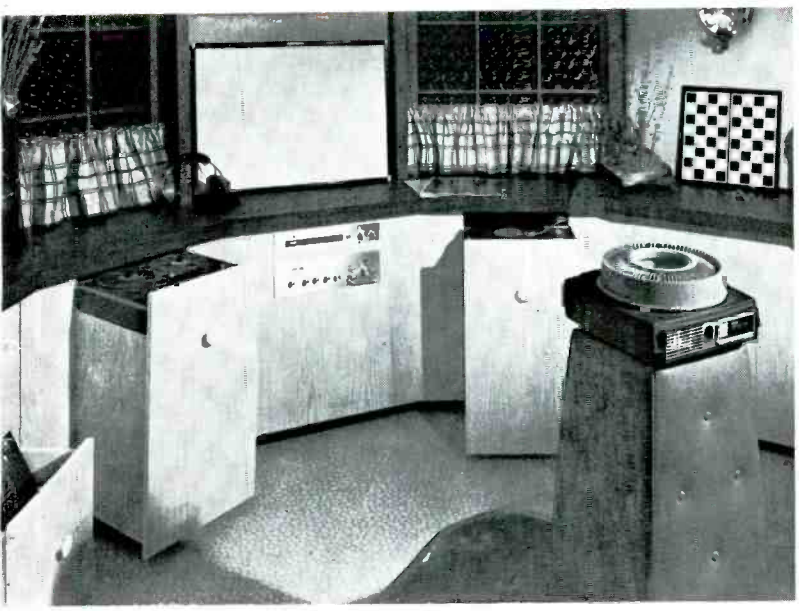
A. Disassemble the E and I laminations. Replace only the E laminations and face them all the same way. Snip all leads except the primary ones going to the 117-volt a.c. supply. Connect these primary leads (via a plug, of course) to your house outlet, and you have a powerful electromagnet which serves as a bulk eraser. The duty cycle of this eraser is about one minute on and several minutes off. You can judge the duty cycle from how hot the eraser gets.

Q. For home recording, confined mostly to taping FM broadcasts, and occasionally a phono disc, would the quality of half-track recording be significantly better than that of quarter-track?

A. This question has been asked, and answered, before, but it still looms importantly to those in the market for a high quality tape machine where the option of half-track or quarter-track heads is offered. Therefore we will consider this question again in this column. For *home* purposes, the quality of half-track recording does not seem *significantly* better than quarter-track. There may be a slight improvement in signal-to-noise ratio, and somewhat less of a dropout problem for half-track recording, but on the other hand the treble losses due to azimuth misalignment are more severe for half-track than for quarter-track. If you plan to do considerable editing, however, you will want to record only in one direction, so then you might as well get half-track heads.

Lantern-disguised speaker systems are placed on either side of the fireplace. Components are built into a writing table in the foreground.

DECORATING WITH STEREO HI-FI



Here are some imaginative decor ideas that illustrate the flexibility of component hi-fi equipment. The room settings are part of the IHF-sponsored exhibit which opened to the public in New York City a few months ago.

At left, we see a recreation room with under-counter, built-in provisions for hi-fi components, and storage for LPs and magnetic tapes. Note, too, a slide projector, which can be synchronized with magnetic tape by adding an inexpensive device. Below it, you can see a complete stereo hi-fi system, including headphones. And directly below, hi-fi equipment is located in an open-shelved bookcase, along with a collection of objets d'art.

Equipment Profiles

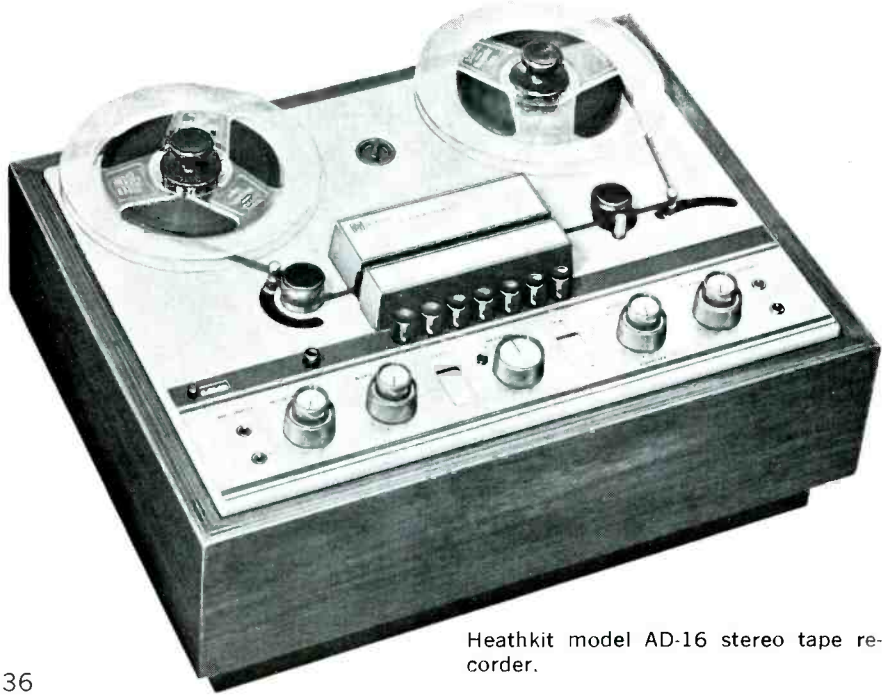
"MAGNECORD BY HEATHKIT" STEREO TAPE RECORDER, MODEL AD-16

The ultimate ambition of most serious tape recordists is to own a professional machine, and this Heathkit model certainly fills the bill ideally. It has three tape heads, three motors, is solenoid operated with pushbutton controls, has adjustable bias control, two VU-type meters, two speeds (7½ and 3¾), and there are considerable savings in building it yourself. There have been other recorder kits, but with most of them you built only the electronics section—the transport was usually factory assembled. But in this model you actually assemble the transport from scratch.

The machine uses three motors, the capstan being driven by a belt from a hysteresis-synchronous motor, and the rewind and take-up turntables are mounted directly on the shafts of two capacitor-start induction motors. Three solenoids actuate the brakes, pressure roller, and the tape lifters. There are three heads—erase, record, and play—which provides the advantage of having each head doing only one job and being designed to do that job best. The transport chassis is a heavy, precision-machined casting which makes for easy and rapid assembly. Everything goes together so easily that the entire transport is ready to be fitted to the electronic section in less than four hours.

There are three sections to the electronic assembly—the power-supply circuit board, the pushbutton switch, and the main electronic circuit board, and they are assembled in that order. The power-supply circuit board contains all the elements of the power supply except the power transformer itself. One of the unusual features of the over-all design is the use of connecting pins on the circuit boards which accommodate matching clips on many of the wires, so that final wiring simply involves pushing the clips down onto the proper connecting pins. This is a time-saving feature, and permits ready access to parts of the circuitry without unsoldering any leads.

The pushbutton switch assembly is completed by soldering 13 precut, numbered hookup wires to terminals, connecting four short pieces of bare wire, and connecting six disc capacitors. The hookup wires used throughout the entire unit are numbered on both ends, cut to the exact required length, and fitted with the aforementioned clips where necessary. There are 38 of these wires, in addition to 24 shielded cables which are made up in the same way, with the ends stripped or fitted with the clips, as required. Furthermore, there are 31 more numbered wires which are made up as a cable harness. Add to this the fact that the three dual-concentric recording and playback level controls are soldered direct into holes in the circuit board, as are 18 of the 29 connections to the monitor/equalization dual-concentric switch, and 18 of the 27 connections to the left/stereo/right selector switch, and it is readily seen that construction is simplified wherever possible. There are still some parts of the work to be done, however, since there are 111 resistors, 79 capacitors, 21 transistors, and four diodes to be inserted in the circuit boards and soldered in place.



Heathkit model AD-16 stereo tape recorder.

In spite of the large number of components, it should be possible to complete the electronic work in 13 hours, and to have the recorder finished by about 20. And with a saving of around $170, this means $8.50 per hour for your work. On the whole, this is a most interesting kit to assemble, combining both electronic and mechanical construction.

Features

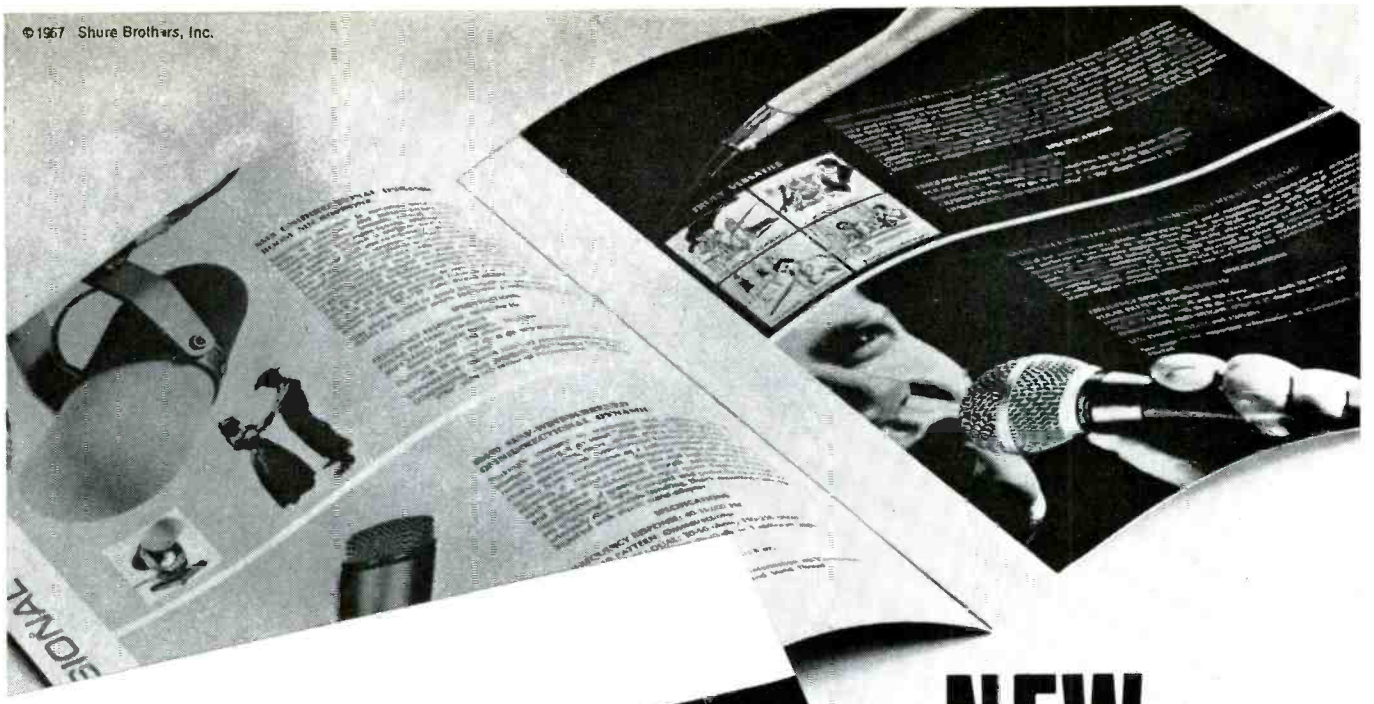
The recorder provides for the mixing of both microphone and high-level inputs, with separate controls for each channel. Two VU-type meters are provided, illuminated when the power is on. The selector switch provides for recording on either left or right channels, or on both for stereo, and a monitor switch permits one to listen to either the source or to the tape, thus allowing instant comparison. Another switch changes equalization for either 7½ or 3¾ ips. At the left side of the control panel are two microphone input jacks; at the right, two headphone monitor jacks. The six pushbuttons, from left to right, are rewind, record, record safety, stop, cue, play, and fast forward. On a recessed panel on the back (or bottom) of the housing are the high-level input phono jacks, and two pair of output jacks—monitor and tape. The monitor output is switchable from source to tape, whereas the tape output is off when the monitor switch is in the source position. The source output and the VU meter feed are taken from ahead of the recording equalization circuit, so the meter indication is truly in accordance with the signal, as it should be, but as it isn't in some machines. The rear recessed panel also accommodates the line fuse and is equipped with two large knobs on which the power cord may be wound for transporting.

Bias frequency is approximately 84 kHz, and provision is made for adjustment of the bias current to suit the requirements of the tape.

Performance

All of this description of the AD-16 leads up to only one thing—the performance—and in this area the recorder is superb. Response curves are shown in *Fig.* 2 for playback from a standard tape and for the record/play operation at both speeds. Both are within specification. Hum and noise, measured by setting an external meter at 0 dB when the distortion measured 3 per cent, and while still recording the input was removed and the tape noise and hum noted. The figure was 53 dB at 7½ ips, 49 at 3¾. An input of 0.25 mV was required at the microphone jacks to provide a 0 dB indication on the VU meters with the gain control at maximum, and 220 mV was required at the high-level input. The output signal for a tape recorded at 0 on the VU meter was 1.1 V. Distortion at the same recording level was 1.2 per cent. Wow and flutter measured 0.1 per cent at 7½ ips, and 0.14 per cent at 3¾.

(Continued on page 38)



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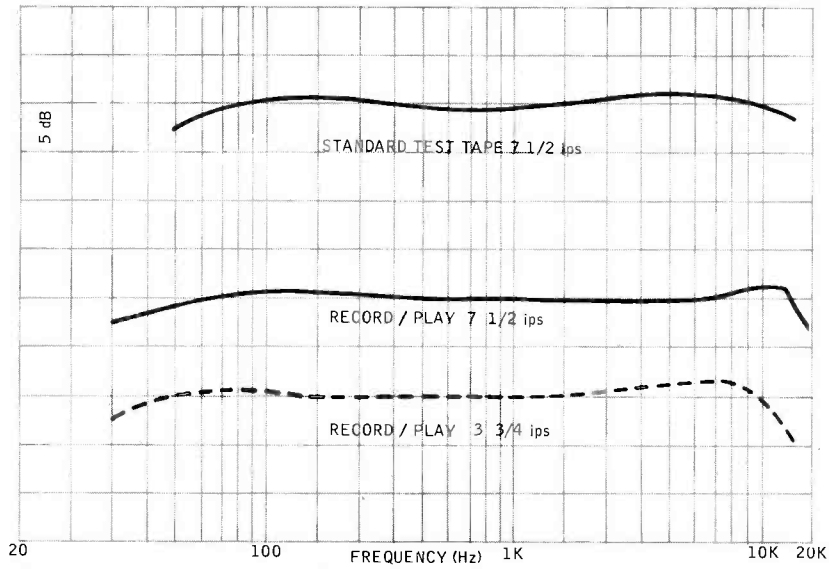


Fig. 2—Response curves from 7½-ips standard test tape and for record/playback at 7½ and 3¾ ips. Both channels averaged less than ± 1 dB deviation.

With these performance data, combined with the smooth operation of the machine, its handsome appearance, and its ability to accommodate 8½-in. reels, it is readily seen that the owner may well be assured that he does have a truly professional machine.

The basic kit is priced at $399.50, and the optional walnut base is an additional $19.95. For mounting in a cabinet or a wall, an extruded aluminum mounting ring is available at $4.75, and $9.95 buys a pair of drawer slides which work with the walnut base for a pull-out mounting. The recorder measures 17 in. wide by 13⅛ in. deep by 8⅛ in. high, exclusive of base, which is slightly larger. (The recorder may be used either vertically or horizontally, and could be rack mounted if desired.) Weight is about 45 pounds. Check 1

SHARPE HA-660-PRO STEREO HEADPHONES

Evaluating headphones must be somewhat subjective—without certain specific types of ear-cavity adapters and suitable microphones, the purely objective measurements are just not possible. Within limits, however, it is possible to check certain of the manufacturers' specifications, and when one has available a number of different models, one can make some comparisons. We do know that most high-quality phones of today will go higher than we can hear consciously. We have had some experience in reading code at 24 kHz yet not being conscious of hearing anything. That was, however, some 20 years ago, and we have been told that the high end of one's hearing drops down considerably as the years go by.

We have had the fun of comparing three sets of Sharpe phones—the HA-10, the HA-660, and the latest HA-660-PRO. Audibly, there isn't so very much difference between them, it appears. They all had excellent frequency response, all put out very close to the same volume, and all looked about alike. (All are dynamic types.)

Sharpe phones are the tops in appearance—the housing is a finely-finished plastic, glossy and smooth, and the "padding" for the ear consists of liquid-filled semi-rectangular "doughnuts" which provide an excellent seal—with them on, we couldn't hear ourselves snapping our fingers. The phones can be worn for long periods without the slightest discomfort, even while wearing glasses. The main "baffle" in the phone is set at a slight angle, and with considerable foam padding around the unit itself, it appears that there is some feed of sound energy from around the baffle. Whatever the principle involved may be, it certainly results in exceptionally smooth sound, with no audible peaks. We were able to make primitive measurements of output, and found that it was possible for a microphone to hear 23 to 25 kHz. The specs claim 35 kHz, but we are not sure about our coupling between the phones and the microphone. Since most of the bass response depends on the tightness of coupling to the ear, these models should come out well up in the scale,

Sharpe Model HA-660-PRO stereo headphones.

for the air seal is about as good as it could be without squeezing the head unduly.

The HA-10A, the lowest-priced model, was fitted with a plastic parallel cord; the HA-660 PRO-VC had a deluxe nylon-braided round cord, using tinsel conductors for extreme flexibility, and each channel had its own volume control and a fuse—a standard plug-in 0.3-amp. type with a plastic covering cap which unscrews to permit changing if overloading occurs.

The latest model, the HA-660 PRO, also had the fuses and the round nylon-braided cord, but no volume control. The model we had was intended for use on speaker lines, but another model (HA-660/PRO-500) designed for 500-ohm lines is available. The PRO is a model which should satisfy any user, largely because of its smooth response, but it is also a handsome product in every particular, as well as comfortable to wear. If the cord were detachable (optional at extra cost) we can envisage some people wearing the phones just to keep out unwanted sounds. With the phones on, one gets the feeling of being in an anechoic chamber until they are plugged into a phone jack, and then one is immediately in the recording studio. The HA-660 PRO is priced at $60.00 for the pair. Check 2

FISHER SPEAKER SYSTEM, MODEL XP55

The Fisher Model XP55 two-way, bookshelf speaker is just over one cubic foot in volume (10 in. high x 20 in. wide x 9 in. deep); small enough to fit in almost any location you wish to place it. Bass and mid-frequencies are reproduced by an 8 in. "free piston" woofer, an air-suspension system whose marque denotes heftier-than-expected bass response from a small enclosure. It has a three-pound magnet, 1¼ in.-diameter voice coil, and about a 33-Hz free-air resonance (according to specifications). Mid-range and high frequencies are reproduced by a 2½ in. cone-type tweeter that features 9/16 in. voice-coil diameter and a ½-pound magnet. A 1000-Hz crossover network with a 12-dB-per-octave rolloff divides the frequency spectrum between the two speakers.

There are no balancing adjustments available to boost or lower high frequencies in relation to bass and mid-range frequencies, but one can employ an amplifier's treble control to good advantage if the listening environment dictates it. Impedance is 8 Ohms. The handsome enclosure, which is veneered in dark, oiled walnut, and has a dark brown rattan grille cloth, can be used either vertically or horizontally, according to whim or decor needs.

Performance

The XP55's frequency response, averaged from measurements taken in five room locations (with compensation applied for calibrated microphones and room characteristic) and outdoors, was

from 40 Hz to 19 kHz ± 10 dB. There were no major irregularities in the response curve. Bass dropped off rather sharply below 60 Hz; the top end commenced to decrease after 13 kHz, being 5 dB down at 15 kHz.

Tone-burst tests showed the XP55 to be a smooth, well-damped performer, confirming the absence of significant response irregularities or ringing. Low- and high-frequency tone bursts, taken one foot away from the active driver, pointed to the small system's ability to handle transients very well. For example, it required only two cycles for the speaker to reach full output on tone bursts of 2.8 kHz and 300 Hz. High-frequency dispersion was within the speaker system's rating of 90 degrees, which is average for a cone tweeter. Though the XP55 will operate with lower-power amplifiers, we recommend 25 Watts rms or higher for use in a 12 foot by 18 foot room. The higher power would enable listeners to reap the full benefits available from this low-efficiency system. Power requirements would be lower for use in smaller rooms, of course.

Fisher XP55.

In listening tests, made in a relatively live room, the XP55 sounded clear and well-balanced. Trying to establish some meaningful reference point to describe its "sound," we'd say that the speaker system leans more toward the mellow side as opposed to exhibiting a "bright" sound. At normal listening levels, the bass line was solid. Only the lowest octave was missing, but we have not heard this octave reproduced in other speaker systems of this size, either.

As is often the case with transducers, technical specifications do not always tell the whole story. The XP55's, for example, do not exhibit the feeling of artificial "presence" that some other speakers do. This is all to the good for many people, who abhor middle frequencies that are somewhat projected. Re-examining our curves, we can only deduce that the strong upper-bass response, along with a flat middle-frequency response, is responsible for this pleasant listening experience.

Though the XP55 is not the type of speaker system that would likely be chosen to fill large rooms at very high sound pressure levels, its excellent characteristics are quickly recognized in smaller rooms, at normal listening levels. Without doubt, a pair of Fisher XP55's, at $59.50 each, should be a good choice for a small room, with a budget allowance at hand. Check 3

MUSIC AND RECORD REVIEW

The Classics

- EDWARD TATNALL CANBY
- OSCAR E. KRAUT
- MARVIN ROTBARD
- LIONEL RUDKO

Toscanini Broadcasts

A Toscanini Treasury of Historic Broadcasts—Never before released. NBC Symphony, soloists, Toscanini. (1940-1949).

RCA Victor LM 6711 (5) mono

There are indeed treasures of various sorts here, chosen from the vast number of broadcasts by the NBC Symphony that took place between 1940 and 1949. There are also some moderately notable klinkers, historic too, though not stressed in the publicity. Both in the music and in the technological aspects of these well-remembered events, as taken down by NBC engineers for posterity.

Added together, these elements still add up to an absorbing album, worth any listener's time. But virtually every one of the works included can be had in much more satisfactory recordings elsewhere, both musically and technically, and this is as it should be. The great glare of high-pressure publicity which attended the broadcasts, the atmosphere of almost hysterical intensity, was not the sort of thing conducive to careful music making and decidedly no atmosphere for the permanence and "repeatability" of a recording. These sounds, then, are of historic interest as much for their faults (as records) as for their virtues.

On the ten sides are Haydn, Brahms, Sibelius, and Shostakovitch, works both well known and less familiar. Two Shostakovitch symphonies, the humorous early No. 1 and the super-mammoth No. 7 ("Leningrad"), then very much loaded with war-time (1944) emotional connotations, the Second of Sibelius and his "Pohjola's Daughter," The Haydn No. 99, and the rarely heard Symphonie Concertante, the "Haydn" Toy Symphony, (here rightly ascribed to Leopold Mozart) and three works of Brahms, all unusual—the Serenade No. 2, the "Gesang der Parzen" and the Liebeslieder Waltzes of Op. 52.

As always with Toscanini, every single one of these works comes out at a speed just a little faster than you would have thought humanly possible. And, as always, all these diverse works somehow manage under Toscanini to sound like Verdi, Rossini, or Puccini. Sometimes this is for the good, as in Brahms, who can be overweight, or Shostakovitch, who tends towards the rhinoceros-hippopotamus approach. But it is bad for Haydn, who is never any good in a tense atmosphere, anyhow. And bad for Sibelius, who thrives on relaxed longwindedness and sounds worse and worse as you push him harder and harder.

Being high-tension broadcasts, these performances are full of dreadful bloopers—mistakes, out-of-tune chords (like the beginning of the Haydn Symphony), out-of-ensemble rhythms, muffled solo passages, sour notes galore, messy detailwork. Inevitable (and somebody has got to say it!). But objectionable in the listening, nevertheless. There are dozens of passages here which would make any modern recording producer turn pale with horror and order a dozen retakes. What more can we expect? There were no retakes, after all. My only objection is—as for years—the publicity which implies utter perfection to all that Toscanini touched. Just listen for yourself.

As to the recording, we all remember it, those of us who lived in the AM days. Actually, the older recordings here, from 1940, 41, 44, are the best sounding musically, though restricted in highs. The 1949 recordings are brighter but also more distorted. Not exactly commendable for that late date.

The sound would be far from objectionable, even so, if it were not for the most monumental technical blooper of all, the famous "sound"—or lack of it—of Studio 8-H, the nearest thing to an anechoic chamber ever devised for concert performance. It is presented here unchanged. Not very much can be done, indeed, to "enhance" such incredibly dead sound. So you'll have to get used to hearing your Brahms, Shostakovitch, Sibelius in a closet. The orchestra, even at high volume level, sounds about three feet wide.

Too bad to have to stress the negative so much. Toscanini was a tremendous personality and you can hear it in this playing easily enough. But after thirty years of RCA publicity, piled up as regularly as the snows and rains of the seasons, one rebels at too much of a corporate muchness. Yes—he's GOOD! But not *that* good. E.T.C.

Classic Piano

Beethoven: Sonata No. 29 in B Flat ("Hammerklavier"). Beveridge Webster, piano.

Dover HCR ST 7008 stereo

Dover's man Webster is one of the best pianists around for the big, serious masterworks that contain even more thought than bravura— Beethoven, for instance.

The "Hammerklavier," at the very beginning of the late-Beethoven period, is open to more differences in interpretation than, perhaps, any other of the

Beethoven sonatas. It can be heavy and thundering, light and passionate, gentle or violent—and all versions, if done with musical understanding, seem to justify themselves with remarkably little trouble. Webster, now just under 60, is of the generation that was just beginning to play the hard, tense, spare "modern" style of the 1930's and 40's; he still retains much of the warmth which prevailed in his master, Artur Schnabel's interpretations — he is an outstanding Schnabel follower—and also the high sense of over-all architecture of that school of Beethoven pianism. He plays with some of the agonizing intensity of the next generation, often hard, often very fast, but not yet with the steely, almost cynical harshness of the young pianists of the war years.

It is a good sound and a fine interpretation, very musical within these "parameters" of style. E.T.C.

Schumann: Symphonic Etudes, Op. 13; Scenes from Childhood. Paul Badura-Skoda, pf.

Westminster Collectors Series W-9342 mono

Schumann: Concerto in A Minor; Etudes Symphoniques. Dame Myra Hess, pf.; Philharmonia Orch., Schwartz.

Seraphim 6009 mono

Two unusually fine piano reissues here, both including that once-war-horse, the Schumann *Etudes Symphoniques* for solo piano, a work in a grand bravura style ("symphonic") that is increasingly hard to carry off successfully these days.

Dame Myra Hess' Schumann was the finest of her generation, before and during the Second War. Her Schumann Concerto (*the* Schumann Concerto) was definitive. Though this version of her great performance came late, it has the essence of that interpretation, very seldom matched for convincing naturalness and authority. There's nothing else like it. Her piano *Etudes,* too, have that combination of grand, theatrical styling and heart-on-sleeve intimacy that is the key to Schumann playing. A splendid, unbeatable and classic performance, this too.

Badura-Skoda, much younger and out of Vienna, has the qualities of gentleness and sincerity that are right for Schumann, and his technique—at least on records—is big enough to get over the grand *Etudes* though they are a bit thinner and less magnificent than Dame Myra's. He adds several "extra" variations, not usually played, which will astonish those who know the music well. E.T.C.

Schubert: "Wanderer" Fantasie; Moments Musicaux. Paul Badura-Skoda, piano.

Westminster WST 17110 stereo

On the regular Westminster label in stereo, this is a new recording from Westminster's long-time piano standby. The huge, tone-poem-like "Wanderer" Fantasie (based on one of his songs, by that name) is one of the toughest musical assignments any pianist can tackle, both in the finger technique (millions of little notes, to be integrated into big shapes) and in the sprawling architecture, which forecasts the whole span of later symphonic writing of the 19th century. Not to mention the ever-weird Schubert harmony-changes, which must be *heard,* not merely played, by the pianist.

In a way, Badura-Skoda isn't "big" enough for this massive work, which many pianists manage to project in one piece via sheer pianistic thunder. This gentler pianist does it by more musical means, which is better though it tends to mire us down now and then in the endless and loosely organized details of a very long piece. He really understands the work.

The smaller Schubert *Moments musicaux* are absolutely delightful. Pure Viennese, and there Badura-Skoda is wholly at home. E.T.C.

Haydn: Piano Sonatas Nos. 20, 23, 52. Martin Galling, piano.

Nonesuch H-71143 stereo

The Haydn piano sonatas, overshadowed by the showier but more precious Mozart sonatas, are coming back—and about time. They've always been prized by a few of us, both listeners and pianists, for their unassuming grace and their often inward-looking content, always bigger and more important than the outward sound. They are real *solo* sonatas, solo for private appreciation, not for concert-style bravura.

Galling does a sensitive job with these, two middle-period ones and one very late, the famous E flat sonata of 1794 that is already semi-Romantic in its passionate expression, its big chords, its astonishing harmony changes. His piano is a European Bösendorfer, generally thought to be the nearest of modern makes to the smaller piano for which Haydn himself wrote. E.T.C.

Organs

Buxtehude at Luneburg—The Glory of the Baroque Organ. E. Power Biggs, organ at St. John's, Luneburg.

Columbia MS 6944 stereo

E. Power Biggs, Columbia's long-time walking advertisement for the Baroque organ, is at his best when inspired by one or another of the great historic organs of Europe, such as this superb large instrument, dating in part from as far back as 1550. It was already famous, and 150 years old, when Bach studied in Lüneburg as a youth. Buxtehude, who was famous in the same region, probably played on it himself, slightly earlier.

This is a well-organized recording on the dual theme of the music and the organ itself, which are perfectly suited to each other. The music is superb, serious but also, as always, full of good humor and a certain peasant-like plumpness and color—not nearly as "heavy" as Bach's later music. The organ is marvelous. E. Power Biggs is not the subtlest Baroque player around, but he does have imagination and enthusiasm—very much needed in this music. It shows in his playing, decidedly. You'll like old Buxtehude!

The Columbia recording is excellent, just right for the music and the reverberant acoustics. Not too close, not too distant, and clean, too, except for some buzzy intermodulation in one particularly tough passage at the end of Side 2, accompanied by a barking dog. E.T.C.

Die Alte Orgel. (Burgkirche Valeria, Sion; Pfarrkirche in Vouvry). Siegfried Hildenbrand.

Telefunken SAWT 9498-B stereo

Here are two smallish old organs in the Valais, Switzerland; one of them, at Sion, is claimed to be the oldest playable organ in existence, dating from the late Gothic period in part, that would be, perhaps, as far back as the 1300's. The other, in Vouvry, is much younger, dating, indeed, from the early 19th century, the tail-end of the classic organ period.

The recording is, somehow, out of focus in its presentation—I might say, crosseyed. The very old organ is a chaste little instrument, somewhat out of tune, and the music played on it jumps disturbingly in mid-side from very old (Obrecht) straight into some rather juicy Italian stuff of the early 18th century. The music of the second side, played on the more sonically varied Vouvry organ, is at least consistent but, again, confusing —it is all French Baroque, by Daquin and Clérambault. The organist is clearly more at home in this latter music. The older works sound stodgy.

Recording is, for U.S. tastes, somewhat distant and too diffuse in detail, without much stereo impact. E.T.C.

Bernardo Pasquini: 15 Sonatas for Two Organs / Harpsichords. Marie Claire Alain, Luigi Ferdinando Tagliavini.

Music Guild MS 139 stereo

Pasquini was a keyboard man, contemporary of the famed Corelli (a generation older than Bach, Handel, and Co.). These little "echo" sonatas were written mostly in a simplified figured-bass format, no doubt intended to be "realized" directly from the figured shorthand at the keyboards. They are not necessarily for either type of instrument, go equally well on organ or harpsichord and, indeed, do a lot to show how closely related those two instruments were. Side one is on organs, side two on harpsichords.

The music is light and charming, the harmonies solid and interesting, so strong that there could be no possible ambiguity in the playing of the sketchy figured

bass. Many bits of melody and sequence are bery much like D. Scarlatti—but his famous little sonatas came many years later. Pasquini was no doubt part of his Italian inheritance of style.

Here we are once more in that enormous Basilica at Bologna with its prodigeous reverb time and its two oppositely placed old organs. Good! The two harpsichords have a similar acoustic setting, with just the right side-to-side play for the sense of the sonatas. E.T.C.

Lighter Moods

Sabre Dance: Philadelphia Orchestra, Ormandy, cond. (collection)

Columbia MS 6958 stereo

Here is yet another of the endless collections that Columbia spills forth, alternating, it would seem, between the Philadelphia under Ormandy and the New York Philharmonic under Bernstein. What a waste of talent!

Not that anything is less than top notch. We are dealing with prime skills here. Only, there must be more important music. Of the 13 selections here 2 are the same as on a recent Columbia/Bernstein outing. And who needs another *Russian Sailors' Dance* of Tchaikovsky *Trepak?* (And on those two I prefer Bernstein anyway.)

Khachaturian is represented three times. There is the title work and there are the *Galop* from Masquerade and the *Rose Maiden* Dance from Gayne. Shostakovitch. Rimsky-Korsakov. Prokofiev, Kabelevsky, Mussorgsky, and Borodin are also represented, the last named by the *Polovetsian Dances.* Perhaps this album should have been called Russian Music.

It's almost embarrasing to say that Ormandy and his Philadelphians scintillate with this kind of music. They are made for much more. M.R.

Falla: El Amor Brujo. Ravel: Rapsodie Espagnole; Pavane for a Dead Princess. Victoria de los Angeles; (New) Philharmonia Orch., Giulini.

Angel 36385 stereo

The great Spanish lady, De Los Angeles, sings only briefly on this record, in the outer movements of the Falla. The rest is all instrumental, in the Spanish manner. The music is rather low-pitched for her but she knows the "gutsy" Spanish style required for the two brief solos and does them well. But there is an oddly muffled sound to her voice—not in the orchestra. I don't know why.

Technically this disc is an outstanding example of current technology in respect to SILENCE. You will notice at once how the music of the opening measures retires down into *pianissimo*—and then on down still further. Not a tick or a pop for minutes on end and barely any noise at all in the background—just enough to give a proper hall sense. (After all who wants an anechoic chamber sound?)

Though the two recordings seem to have bridged the gap between the old and new Philharmonia orchestras, corporately reorganized, there is no important difference between the pair. I liked them both. E.T.C.

Tales From Vienna: The Boston Pops, Arthur Fiedler, cond.

RCA LSC-2928 Stereo

Here is a delightful bon-bon from Boston. Seven Viennese pastries from Johann Strauss, Jr.: *Tales from the Vienna Woods, Artists' Quadrille, Egyptian March,* the *Gypsy Baron: Overture, Champagne Polka, Wine, Woman and Song,* and the *Excursion Train Polka.* And as an extra *vorspeise* the *Fireproof Polka* of Josef Strauss.

It's clear, even on casual listening, that a good time was had by all. Fiedler is in lilting form and his Boston players fall right into the spirit he casts for them. Well, perhaps it's not the real Vienna that peeks forth from discs that do come out of that fabled city. But no matter. This is a sort of music to enjoy, not analyze. And what RCA has done is provide a most enjoyable time for us all. M.R.

Opera

Verdi: Don Carlo. Christoff, Filippeschi, Gobbi, Neri, Stella, Nicolai Orchestra and Chorus of the Rome Opera, Santini, cond.

Seraphim 1c—6004

By and large, Angel has performed a commendable service for the record collector through its reissuance of some of its early masters on the Seraphim label.

This recording of *Don Carlo,* sadly, is one of their less successful efforts. To begin with, *Don Carlo* as a work in itself is not of first-rate calibre. It is not in the class of *Otello* or *Falstaff* in musical consequence, nor does it contain the "hit" arias of the more popular operas. Nevertheless, that it contains sufficient elements to include it in the repertoire of great operas, cannot be denied.

The recording itself is technically inferior to some of the other Seraphim releases, having excessive distortion of the high-level passages, particularly the choral ones.

Christoff and Stella, as King Philip and Elizabeth, carry the bulk of the burden and bring what vocal consistancy there is to the album. Mario Filippeschi as Don Carlo has a good voice but is erratic and uncontrolled, singing sometimes well and sometimes poorly throughout. Tito Gobbi and Elena Nicolai are similarly spotty, unusual for these two artists. To devotees of this opera, I recommend either of the later recordings by London and Deutsche Grammophone, with a leaning towards the London version.

The Doves and Hawks of today might be interested in this dialogue between Philip and Rodrigo, to wit; Philip, "Only with bloodshed could I give peace to the world." Answers Rodrigo, "Do you think, by sowing death, to plant for future years?" History never changes, only the time in which it is made. L.R.

Gerard Souzay Sings Operatic Arias. Orchestre Des Concerts Lamoureux, Serge Baudo, cond.

Philips PHS 900-109

If you are a smorgasbord lover you should find a good deal to enjoy in this recording by Philips.

Gerard Souzay is an old friend and a mature and sensitive artist. His accomplishments as a singer of art songs are well known. He is less familiar in operatic roles. Therefore, this disc promised to be of unusual interest and doubly so because of the choice of repertoire for the recording. There are a few of the war horse brand of arias from *The Marriage of Figaro,* two from *Don Giovanni, The Pearl Fishers,* and *Orfeo ed Euridice,* but the less familiar selections add the real spice to the dish. In particular, I refer to *La Jolie Fille de Perth, Hamlet,* and *Romeo et Juliette.*

The former are performed in a professional manner, but lack excitement and lustre. The Mozart *Fin eh'han dal vino* immediately brings to mind the magnificent Pinza, unsurpassed to this day. The latter French group however, are a real delight, here Souzay is in his idiom.

If you are tired of the same old fare, which most excerpt records are, this one will titillate your palate. Conductor Serge Baudo does a more than first-class job in collaborating. He deserves a great deal more exposure. L.R.

Puccini: Opera for Orchestra. Kingsway Symphony Orchestra, Camarata, cond.

London Phase 4 SPC 21019 stereo

La Boheme, Madama Butterfly, Tosca. and Turandot are the operas treated to these arrangements by conductor Camarata, I must confess that I was prepared to dislike them on two counts. First, I take my opera the way it was written. Second, I do not have a high regard for these Phase 4 records. I must say that on both counts I must do some reconsidering.

Puccini's lush melodies translate well. Camarata has dealt tenderly with them. Perhaps he might be called over-lush both as arranger and conductor. But it does not matter. Puccini music fares properly under such treatment. His approach is on the order of musical montage and I am inclined to feel that his belief is vindicated. He has captured the breath of Puccini's sound.

Phase 4 is Phase 4. It continues to present discs that are cut at altogether too high a level. Too *much.* With current generation cartridges you can get away with it. But is it necessary?

The fact is that this is a startingly clear record *except* at a climax. Then I fear, it becomes almost too much for any cartridge. It's a pity, for Puccini/Camarata deserve better. M.R.

Old Standards

Tchaikovsky: Symphony No. 6 in B Minor (Pathetique). The Philharmonia Orchestra, Carlo Maria Guilini, cond.

Seraphim S-60031 stereo

Why is it that Italian conductors have seemed to have so thorough a way with this Russian master's music? Toscanini was its ultimate master and here is a successor. This recording must be fairly recent, it's my first encounter with it. But it will not be my last.

From the subdued opening of the Adagio of the first movement, Guilini is in firm command. He builds, oh so carefully, as the natural tension of the work increases. His exposition of detail is outstanding.

This last work of Tchaikovsky is filled with musical contradiction. I can not yet accept the final movement as logically following the *vivace* third movement. Did Tchaikovsky know he would be dead in a matter of weeks after the premiere performance? He died of cholera contracted by drinking unboiled water. Did he know this and thus commit suicide? Or was it an accident. Musicologists will argue that one forever, I expect.

But no matter. Seraphim has done a real service by issuing this work. I would recommend it at the high price usually reserved to the prime labels. At the bargain you can get Seraphims for, this is the Tchaikovsky No. 6 to have. M.R.

Elgar: Five Pomp and Circumstances Marches, Froissart Overture, Elegy for Strings, Sospiri. New Philharmonia or Philharmonia Orchestra, Barbirolli, cond.

Angel S 36403 stereo

It becomes almost redundant to say that there are not nearly enough Elgar works in the current catalogs. *The Pomp and Circumstance March, No. 1 in D major* is certainly well known and must be represented in many a collection. But there are four more gems that comprise the Opus 39 and they are given a rousing hearing here. Sir John and either of the orchestras here represented have an established affinity for Elgar's music. At least four other albums on the Angel label have been conducted by Barbirolli. And if memory serves me correctly, he is a concert hall champion too. M.R.

Russian Orchestral Masterpieces. Tchaikovsky, Glinka, Borodin, The Czech Philharmonic Orch. Karel Ancerl, cond.

Crossroads 22 16 0086 stereo

Tchaikovsky is represented by the *1812 Overture* and the *Capriccio Italien*, Glinka by the inevitable *Russian and Ludmilla*, and Borodin by *In the Steppes of Central Asia*.

I was prepared to dismiss this disc rather casually, the sound is so-so, the playing is marred by bloopers. Then I listened a bit more carefully. It would seem that these are first-take recordings with no attempt to correct small errors. The whole effect, therefore, is one of considerable spontinaety.

At the same time, I can't get too excited about the conducting job. Ancerl is somewhat erratic in his beat. And Crossroad's sound seems as if the wrong road was crossed. (Crossroads is a subsidiary of Epic which is, in turn, a division of Columbia—they all belong to CBS, Inc.) Crossroads is the low-priced entry and, if this sample is typical, it would seem that they are trying to discourage the buyer of $2.50 records.

I just don't see any need of this record. M.R.

Choral

Choral Hymns from the Rig Veda. Opus 26, No. 3; Savitri, Chamber Opera Opus 25. Janet Baker, Robert Teav, Thomas Hewsley. English Chamber Orchestra—Imogen Holst.

Argo—ZNF-6

The listener with inclinations towards musicology will find ample reward in this unusual disc by Argo.

This excellently recorded performance affords the opportunity to explore the little known side of a composer familiar to us all. Listening to these works, it is hard to believe that they emanate from the same creative talent that gave us *The Planets*, *The Perfect Fool*, and the *St. Paul's Suite*.

The Choral Hymns from the *Rig Veda* are the most interesting of the works herein. They are a product of Holst's Hindu period which developed in the late 1890's and culminated in the early 1900's. Hymns No. 2, 3, and 4 have some lovely lyrical passages and vocal interplay that capture the introspective serenity of Hindu philosophy. Some of the loveliest harp sounds on records are found in these pieces.

The opera *Savitri* is less successful in retaining listener interest. The music is rather repetitious and seemed to me to contain more Wagner cliches than it did Indian influences.

Considering the recent successes of Janet Baker, her performance here is vocally disappointing. The small orchestra is capably directed by the composer's daughter, Imogen Holst.

This is by no means great music, but is a worthwhile diversion for the satisfied classicist. L.R.

Light Listening

- Richard L. Lerner
- Chester Santon
- Robert Sherman

Bob Dylan, Poet: dramatic readings by Sebastian Cabot; music arranged and conducted by Irving Spice.

MGM SE 4431 stereo

The Immortal Songs of Bob Dylan: The Gotham String Quartet.

Philips PHS 600-218 stereo

People who consider Bob Dylan a first rate composer and/or one of America's great, creative poets (and there are quite a lot of them, I understand), will do well to investigate these intriguingly off-beat recordings, even though neither one offers the material in anything approaching Dylan's original concepts. In the case of the MGM album, the music is discreetly played in the background by a string orchestra, while center stage the Dylan verses are caressed, orated, growled, purred, and otherwise emoted by actor Sebastian Cabot. It's an interesting idea, and despite the histrionics, it works pretty well. *Don't Think Twice* and *Tomorrow's a Long Time,* to name two of the better entries, emerge with surprising tenderness and sensitivity, while the anti-boxing polemic *Who Killed Davy Moore* packs quite a punch of its own.

If the words dominate the MGM disc, they are dismissed altogether in the Philips album, which offers another dozen Dylan tunes (six of them duplicates, actually) in performances by a string quartet. Most of the melodies can't really hold up under such careful scrutiny, but the sheer novelty of the thing is enough to carry the day in amusing fashion. The settings are generally classical in derivation, but with just enough anachronistic slides, twists, and syncopations to keep the musical illusion from being complete. This is a bit of a shame, since the tunes do take on a piquant flavor with their clever à la Boccherini trappings, and the modern touches tend to be distracting. L.R.

So Much for Dreaming: Ian and Sylvia.

Vanguard VSD 79241 stereo

Ian and Sylvia, the greatly gifted Canadian duo, have taken a turn for American country-and-western music in their latest disc outing, and I, for one, wish they hadn't. The nasal twang and strident, whiny vocalism they affect in about half the numbers here are excellent facsimiles of the modern Nashville style, but their singing only rarely achieves the blend of warmth and spontaneity that was their earlier stock in trade. The pop-sounding accompaniments, complete with electric bass and brush drums, also tend to negate the folk flavor of the songs. Happily there are two exceptions, imaginatively arranged and superbly sung in the Ian and Sylvia manner of yore: one is a striking version of the old English carol *Cutty Wren,* the other a latter day Canadian romance, *Si Les Bateaux.* L.R.

Irish Night at the Pops

RCA Victor LSC 2946

Does the Boston Pops play better at a recording session that happens to include a full audience in its regular hall? It seems to in this recording as it has on past similar occasions. Does the Pops sound better on stage in a recording with audience than it does on the floor of Symphony Hall in a Dynagroove recording session? That one's a bit more difficult to answer. Loyal fans of the Boston Pops have had ample opportunity to judge its recordings under both circumstances. The festivities of the annual "Irish Night at the Pops" provide the most recent opportunity to sample the sound of the orchestra in a straight, non-Dynagroove recording. The audience makes itself felt by breaking into the act with random verses in the George M. Cohan medley that ends the album. Leroy Anderson's well-known Irish Suite, recorded at least once before by the Pops, opens the album in honor of the occasion. For all the use of multiple mikes to maintain flexibility in pick-up pattern with an audience present, the orchestra doesn't convey as much of an impression of size as it does in a recording session held on the floor of the hall. Spread out in the area where the audience usually congregates, the Pops appears more comfortable despite the slight modifications Dynagroove makes in their sound. But there's no denying the very important part played by audience support when the orchestra takes on a crowd-tickling novelty such as the Anderson arrangement of *Old MacDonald Had a Farm.* Stereo really comes into its element here as sections of the orchestra vie with one another to keep up with the sound effects man located in the percussion section. The strings have their inning in the sweet sonority of *Danny Boy,* and the remaining selection, *Count of Luxembourg Waltzes* reminds us that even Irish Night at the Pops is not complete without a sampling of some of the orchestra's Continental specialties. C.S.

Sound Tracks/ Original Cast

Grand Prix (Original Sound Track)

M-G-M 1E 8 ST

There aren't many sound-track albums around these days capable of whetting my appetite on the basis of their packaging. Since a record reviewer sees far fewer films than he'd like to, a sound-track album has to be more than a mere reminder of something he's already enjoyed in a medium giving him sight as well as sound. On its cover, at least, the "Grand Prix" sound track looked like an impressive candidate for review, even though I haven't seen the Cinerama film from which it's taken. Bold letters proclaim "Academy Award Winner Maurice Jarre has created a towering musical score that captures the sight, the sound, the acrid smell, and the frenzy of the auto racing life." I can't vouch for the sight or the smell but the impact of this score didn't exactly bowl me over. Only briefly is the sound of racing cars of Grand Prix Formula One competition heard with a studio orchestra that grinds out Jarre's music. Whatever excitement there is in the score, it seems to me that only a visit to an adequately-speakered movie house will establish its presence. C.S.

Thoroughly Modern Millie: music from the original film soundtrack, starring Julie Andrews and Carol Channing.

Decca DL 71500 stereo

The title tune that Sammy Cahn and Jimmy van Heusen concocted for "Thoroughly Modern Millie," an affectionate film parody of life in the roaring 20's, is a thoroughly campy, infectious little affair. Lucky thing too, since it crops up in five of the thirteen bands on the soundtrack album. Julie Andrews, pert, high spirited and captivating as always, brings her pristine vocal clarity to such nostalgia-inducing items as *Baby Face, Poor Butterfly* and *Jimmy,* and she even makes a game attempt, Yiddish and all, to capture the *freilach* of a Jewish wedding song, *Trinkt le Chaim.* (Cute, but about as authentic as gefülte fish at an English chop house). Carol Channing is an ebullient delight in two zippy flapper tunes, *Do it Again* and *Jazz Baby,* reviving happy memories of her charlestonning Gladiola Girl debut on Broadway in the 1948 revue "Lend an Ear." For the rest, there's another semi-spoof Cahn-Van Heusen tune, *The Tapioca,* a creditable version of *Rose of Washington Square* by an unidentified blues singer, some lively orchestral segments arranged and conducted by Andre Previn, and a final playout of *Thoroughly Modern Millie* in case you missed it the first four times around. L.R.

By Jupiter (Original Cast of 1967 Production)

RCA Victor LSO 1137

RCA Victor has used the occasion of a recent revival of "By Jupiter" to fill us in on a little known entry in the imposing list of musicals Richard Rodgers has brought to Broadway. This show was first produced way back in 1942 during the last years of the celebrated collaboration Rodgers enjoyed with lyricist Lorenz Hart. Ray Bolger was the star of "By Jupiter" and the production ran for 427 performances, an amazing figure when you consider how little is remembered

of the show today. Hearing the score now one is immediately struck by the high standards Broadway producers expected of their singers in those days. Plots based on ancient myths, no matter how difficult for singers, were a great favorite then. This story of a make-believe kingdom inhabited by Greeks and Amazons required a cast able to negotiate lyrics that combined modern slang with the highfalutin' language Broadway invariably ascribed to the ancients. Several songs immediately identify themselves as vintage Rodgers melodies. Of the entire score, any one of three selections may strike a chord of recollection with the listener thoroughly familiar with show music. All three have appeared at some time or other in albums by singers unafraid to stray off the beaten path in their choice of Broadway repertory. *Wait Till You See Her* is perhaps the best known piece in the show, closely followed by *Everything I've Got* and *Careless Rhapsody*. The performance of a fine group of singers places this revival just about halfway between off-Broadway and the Main Stem itself. In assembling the cast, producers Robert Cherin and Christopher Hewett have managed to obtain easy professionalism from fresh-sounding voices, just the right formula for an out-of-the-ordinary musical. C.S.

Big Bands: Here, There, Yesteryear

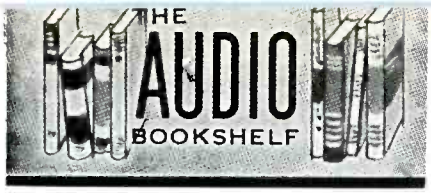
Heath vs. Ros (Round 2)
London SP 44089

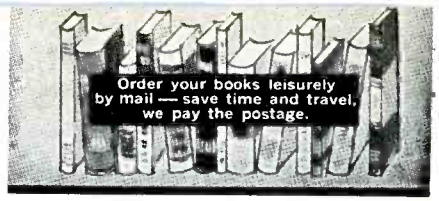
Those who missed Round 1 of the musical battle between the orchestras of Ted Heath and Edmundo Ros now have a chance to hear these British bands in further collaboration. As set up in Phase 4 stereo, Edmundo Ros, with his extra complement of Latin percussion instruments, occupies the left channel while the heavier-in-brass Heath band fills the right channel. Each band consists of sixteen men yet the nature of their combined sound presents a greater stereo challenge to a home music system than most of the conventional symphonic repertory. For one thing, the mikes are in closer than they could possibly be placed for realistic sound in the case of a 100-man orchestra. There are no strings in these dance bands to cushion the impact of the combined brass sections. A good part of the time, London's stereo cutter and the listener's pickup at home have to cope with brass sections filling the right and left channel in unison. When the spotlight is almost entirely on one band in this collection of old favorites, the recording appears almost normal except for the extreme side placement of a full dance band in your listening area.

There are a few instances in existing symphonic stereo discs where a dual-brass problem exists. The augmented brass bands in the Berlioz "Requiem" immediately come to mind as a heavy simultaneous challenge. In the case of Berlioz, however, you have a much larger air mass between brass sections and microphones to cushion the sonic blow. This disc, on the other hand, really provides a workout for any stereo pickup that claims any of the desirable elements of the best in modern design. It doesn't matter what a recent cartridge can do with test tones. It will have to go some to make complete musical sense out of the two channels in this particular recording. Before blaming any cartridge for whatever discomforts there are in the brass climaxes of this disc, we must keep in mind that London Records didn't make things any easier for the stereo cutter by insisting on a high level on the finished disc. Don't let my reservations about the cutter's unavoidable problems dampen your curiosity about this disc. The musical impact alone should bowl over anyone intimately familiar with the first attempts to put stereo information into the groove of a phonograph record. The tape version of this same recording (London 4-Track LPL 74089), skirts the problems encountered by the disc cutter but introduces the usual limitations found in most mass-produced stereo tapes. Both the frequency range and dynamic range fail to come up to those found in the disc version. C.S.

The Best of Artie Shaw
RCA Victor LSP 3675
The Best of Tommy Dorsey
RCA Victor LSP 3674

Here are two re-issues of the Shaw and Dorsey bands reprocessed for electronically-made stereo. As with so many other electronic-stereo re-issues, the interest of the listener, if he's old enough to know the artist on an originally-heard basis, is less on the enhancement of sound and more on the material itself. It's always something of a jolt, although a pleasant one, to hear on today's equipment recently remade disc performances that one grew up with. What an era that was! No wonder they called the age of Shaw, Dorsey, and others, "The Swing Era." The loose-gaited beat of bands such as these make today's outfits—the few still left in the business—sound pretty rigid in their music making. The Artie Shaw aggregation has been placed first in the listing above because the surface noise of his old masters is quieter than Dorsey's. Frequency response is naturally quite similar in both discs with slightly better bass available in the Artie Shaw. In those days a top-selling band spent about a third of its time in the recording studios. Both Shaw and Dorsey left an enormous number of recordings in the Victor vault. Under the circumstances, it would be rather difficult to include all of their "best" work on a single LP. However, just about all the selections heard here are top drawer and each album is quite representative of a typical evening's program the band might have presented at a major ballroom. C.S.





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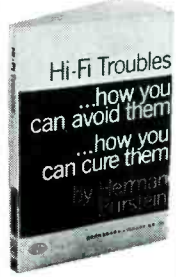

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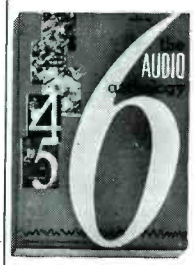

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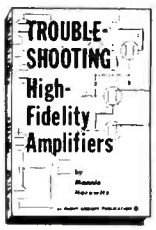

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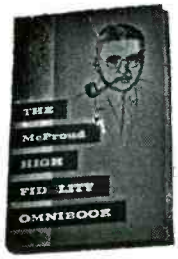

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Jazz and All That

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RCA Victor Mono LPV-540

Sixteen great examples of the fine art of skiffle playing are featured on this Vintage Series reissue. Five groups are heard in waxings that date from 1926 to 1932: the Dixieland Jug Blowers, Five Harmaniacs, Memphis Jug Band, Tiny Parham and His Musicians, and the Washboard Rhythm Kings. All of these groups consisted of skilled city-trained professionals, and their work is of a far more sophisticated variety than that of the country jug bands. Most remarkable of the entire collection are *House Rent Rag* and *Banjoreno*, two sides made in 1926 by the Dixieland Jug Blowers with Johnny Dodds on clarinet. But everything on this great reissue is fascinating, vibrantly alive, and great fun. As Victor makes clear with each new reissue in this series, there's a lot more sound on old 78's than we used to get through our cactus needles. B.S.

Peter Walker: Rainy Day Raga
Vanguard Mono VRS 9238

Peter Walker is a guitarist-composer who serves as musical director for Dr. Timothy Leary's "Celebrations." He has been credited with adding a new sound to American folk music by blending the ancient concepts of the Indian raga with the melody line of American folk song. Whether the result should be classified as folk music or as the highly personal creation of a highly talented musician, the performances are fascinating, eminently listenable, and strangely satisfying. In addition to nine of his own compositions, Walker offers an unusual treatment of the Lennon-McCartney *Norwegian Mood*. The somewhat subdued accompanying group consists of Monte Dunn, 2nd guitar, Jeremy Steig, flute, Alex Lukeman, 12-string drone, Bruce Langhorne, tambourine and bells, Jean-Pierre Merle, tamboura, and Peter Winters, om. The monophonic version probably lacks some of the textural interest that this music could gain from stereophony, but it is clean, crisp, and well-balanced. B.S.

Jim Cullum's Happy Jazz Band: The Real Stuff
Happy Jazz Stereo AP-87
Jim Cullum's Happy Jazz
Happy Jazz Stereo AP-93

Anyone who thinks traditional jazz is on the wane should listen to these two brilliantly recorded platters from San Antonio, Texas. Headed by Jim Cullum, Sr., who plays a clarinet with a mean low register and is gainfully employed in the wholesale grocery business, the band consists of a group of real musicians who have turned to other fields for a livelihood but who have maintained their professional skills. They have the clear benefit of years of working together, and their performances are confident and sincere. Their repertory consists of such fine old classics as *Winin' Boy, New Orleans Stomp, Fidgety Feet, I Ain't Gonna Give Nobody None of My Jelly Roll, Lizard on a Rail,* and *Willie the Weeper*. This is dixieland of a steady, uncomplicated, and unembellished variety. It has received splendid wide-range recording by E. D. Nunn of Audiophile Records. Readers who have difficulty finding these discs locally may write Happy Jazz Records, 110 Oak Park Drive, San Antonio, Texas 78209. B.S.

Lionel Hampton: Jazz Man for All Seasons
Folkways Mono FJ2871

Of the dozen numbers on this collection of great Hampton performances, three are from previously unreleased tapes. They offer atmospheric versions of *Tenderly* and two Hampton originals, *The Price of Jazz* and *C Minor Blues*, performed by a small group consisting of Zeke Mullins, piano, William McKel, guitar, Lawrence Burgan, bass, and Wilbert Hogan, drums. Kenny Burrell replaces McKel on *Tenderly*. The balance of the platter has been selected from recordings previously issued on the Glad or Glad-Hamp labels. They include work with small, medium sized, and large groups, and all of the waxings have the breadth of spirit, elegance, and poise that are so characteristic of Hamp's best performances. A fine booklet of album notes by Charles Edward Smith adds to the value of this set. B.S.

Bola Sete
Fantasy Mono 3364

Two different sessions with popular, Brazilian guitarist, Bola Sete, are represented in his latest album. In three tunes recorded in San Francisco, Sete is heard with percussionist Johnny Rae. They play *Influenca do Jazz, Voodoo Village,* and Sete's own *Bolide* and *Original Joe's*. A second musical line was overdubbed on bass guitar as well as on classic guitar. Five of the remaining six numbers on the set are original Bola Sete compositions: *Lamento de Negro, Sarava, Be-Bossa, Just Another Love,* and *The Girl from Lodi*. They were recorded in Los Angeles with the backing of Monte Budwig, bass, Nick Martinez, drums, and Paul Horn, flute. Acoustically, there is a marked difference between the San Francisco overdubbings and the group recordings from Los Angeles. The former sound as if they had been made in a small, live chamber and then treated with artificial reverberation. The other bands have a leaner, more natural quality. But all of the music benefits enormously from the abundant talents of this marvelous, free-wheeling guitarist who makes everything sound like an easy, relaxed romp and again displays one of the most sophisticated rhythmic talents on the musical scene. B.S.

Bill Black's Combo: Black Lace
Hi Stereo SHL 32033

Maybe it wasn't intended as such, but the present disc is a superb documentary of a kind of small group that has been prevalent in American music for at least 25 or 30 years. This is a recording that quite properly belongs in the time capsules designed to show later generations just what our culture was really like. If I have ever encountered this particular sax-electric organ-trombone-guitar and rhythm outfit, my memory has let me down. But their carbon copies exist in small night clubs, dance halls, and road houses all over the country. They play together, provide a strong beat for dancing, provide a modest amount of cautious improvisation, and a few obviously calculated and carefully rehearsed endings. Like their usual repertory, the present collection offers something for everyone: *You Call Everybody Darling, Jersey Bounce, Stardust, Stomping at the Savoy, Bunny Hop, Rambler, Begin the Beguine, Moonlight Serenade, Sugar Blues, Beer Barrel Polka, T.D.'s Boogie Woogie,* and *South*. The stereo sound is quite realistic. B.S.

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KIT EXPERTS—Dynaco Specialists—Kits at reasonable prices are our specialty. Also custom-wired kits guaranteed to exceed factory standards at substantial savings. Beautiful handcrafted walnut cases for complete Dynaco line, plus everything in audio. Kitcraft, Dept. A567, 738 Washington Avenue, Brooklyn, N.Y. 11238. MA 2-5230.

HARPSICHORD: Same as owned by Philadelphia Orchestra and RCA Victor. In kit form for home workshop assembly, $150. Clavichord kit, $100. Free brochure. Write: Zuckermann Harpsichords, Dept. R. 115 Christopher St., New York, N. Y. 10014.

FOR SALE

"CROWN" Professional Recorders: New and used. Reasonable prices. Wiegand Audio Labs, 221 Carton, Neptune, N. J. 07753.

TAPE RECORDERS, Hi-Fi components, Sleep Learning Equipment, tapes. Unusual Values, Free Catalog. Dressner, 1523T, Jericho Turnpike, New Hyde Park, N. Y. 11040.

DISC RECORDING EQUIPMENT: Cutterheads, Recording Amplifiers, and Lathes. New and used. From Rek-O-Kut to Scully. Send requirements. Wiegand Audio Labs, 221 Carton, Neptune, N. J. 07753.

ALTEC LANSING franchised dealer. Price list and brochure sent upon request. Superior Sound, 621 So. Main St., N. Syracuse, N. Y. 13212.

FREE! Send for money-saving stereo catalog AM and lowest quotations on your individual component, tape recorder, or system requirements. Electronic Values, Inc., 200 West 20th St., New York, N. Y. 10011.

FOR SALE. Citation A, minor modifications, details available, $200. Citation B, $200. Both, $350. J.M.C. Box 135, Huntingdon Vly, Pa. 19006.

ATTENTION EXPERIMENTERS! New HAMMOND Stereo-Mono reverberator mechanisms—$7. Net. Cal's, Box 234, Dearborn, Michigan 48121.

G.I. WRIST WATCHES, WALTHAM $7.95, Govt. Surplus Electronics Pictured Catalog 25c. B F, 44A, Hawthorne, Mass. 01937.

CITATION II $90; Crown SA 30/30 $100; Magnacord 1024; Citation III $95; Ampex 960 $260; Ortofon SPU/E $60 new; REA extra. G. A. Pratt, 2908 Waverland N.W., Cedar Rapids, Iowa 52405.

THE PERFECT GIFT for the audiophile. The unique TRANSCRIPTOR stylus pressure scale is a laboratory-type instrument, accurate to 1/50th gram. Jewelled unipivot bearing, bubble read-out, adjustable cursor, supplied complete with weights and tweezers. Whether stylus pressure is pre-set on your equipment or relies on you for regularing, the TRANSCRIPTOR stylus scale gives the final OK. $7.95 including air postage. Wilmex Limited, Compton House, Malden Road, New Malden, Surrey, England.

FOR SALE

SHACKMAN ELECTROSTATIC SPEAKERS. British. 180° dispersion. This midrange treble can be used with any woofer. Brochures, reports, and prices sent on it and full-range systems manufactured in Canada. Olson's Audio House. Box 1075. Wetaskiwin, Alberta, Canada.

TAPE RECORDER SALE. Brand new, nationally advertised brands, $10.00 above cost. Arkay Sales Company, 1028-H Commonwealth Avenue, Boston, Mass. 02215.

FOR SALE—Parabolоid microphone mounts. TAPERS: make your own wildlife recordings of birds, animals and nature sounds. Several sizes I have used last three years. Eighteen to forty inch, mostly short focus for portability so you can take the tools to the subject for real adventure and best signal/noise recording. Send stamped, addressed envelope for descriptions. Carl Frank, Creeknoll, Route 1, Rochester, Minnesota, 55901.

THINNING OUT private collection. LP's $15.00 dozen. Choice of religious, classical, jazz, misc. Also 2 Fisher 80C preamp-mixers $40.00 each, Jap Electrostatic Tweeter $15.00. Sherrod, Crab Orchard, W. Va.

SCULLY Professional Tape Recorders, from 1 to 12 tracks, complete recording studios available in prewired console cabinets starting at $8,000.00. 70% financing. WIEGAND AUDIO LABORATORIES, 221 Carton, Neptune, N. J. 07753.

AMPEX 1260. Excellent $280. Citation III-X. Excellent $130. Fisher KS-1B like new $35. RDD, 4022 Medford, Huntsville, Alabama 35802.

NOW AVAILABLE JAPAN'S FINEST AUDIO EQUIPMENT. Turntables: TEIC (Magnefloat), KS, NEAT. Tonearms: Grace, Fidelity Reasearch, Audio Technica, NEAT. Record Players: NEAT, KS, CORAL, CEC. Cartridges: Satin, NEAT, Micro Seiki, Fidelity Research. Amplifiers, Tuners: Lux, CORAL. Receivers: Chryslers, Eroica, Tokai. Speakers: CORAL, Chrysler, Lux, Sonics. Dealer Inquiries invited, direct from importer to you. We can secure speical items on request, advise make and model number. Audio Imports, 1415 North Lilac Drive, Minneapolis, Minnesota 55422.

ROBERTS 997 tape recorder, very good condition. $200 or best offer or will swap for superior turntable, arm and cartridge. Box AD-4.

EQUIPMENT WANTED

WANTED: Electro-Voice Georgian low-frequency enclosure without speakers or exterior cabinet. Rodney Yarbrough, P.O. Box 186, Celina, Tex. 75009.

WANTED—ONE ALTEC TUNER Model 306A or 304A. If you have any Altec tuners, let me know. Arden Robl, 308 Ohio St., Oshkosh, Wis. 54901.

WANTED: Used Heathkit 21" color T.V. set, in good condition. Also Dual 1009 in good condition, base and dust cover. Write Stephen McGarity, Box AJ-1. Send price quote and condition.

WANTED — Ferranti ribbon arm and pickup head—less transformer, complete or parts. Dan Seigel, 191 Frederick St., #24, San Francisco Calif., 94117.

MISCELLANEOUS WANTED

WANTED: Copy of plans old University Classic Spencer enclosure Circa-1956. Ernest E. Harley, 4208 E. Capitol St., N.E., Washington, D.C. 20019.

Industry Notes

Benjamin Electronic Sound Corp., importer of Miracord turntables and manufacturer of Benjamin compact systems, merged into *Instrument Systems Corp.* recently. Right on the heels of this, Benjamin Electronic Sound announced that it has taken over the importation and distribution of *EMI* speakers (the "dangerous speaker") and sound products for the United States and Canada.

Electro-Voice, Inc., a diversified producer of electro-acoustic devices, known to AUDIO readers for its speakers, microphones, amplifiers, tuners, receivers, phono cartridges, and electronic organs, among other hi-fi equipment, reached an agreement in principle on its acquisition by *Gulton Industries*.

Bell & Howell plans to acquire *Greentree Electronics Corp.*, manufacturer and marketer of magnetic tape under the American Brand label as well as private label tapes, and supplier of lubricated tape products to the tape cartridge industry, it was announced. Greentree's Stereotape division merchandises reel-to-reel recorded tape under the Reprise, Warner Brothers, Dot, Capitol and Hamilton labels. At about the same time, Sidney Brandt, General Manager of Greentree Electronics since January 1966, was elected president of the firm.

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