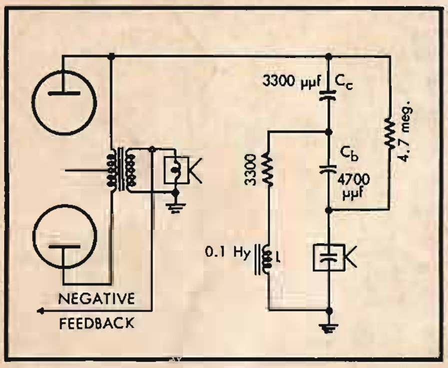
654
Amp.

SEPTEMBER, 1955

50¢

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION



Claims for electrostatic speakers have overshadowed technical information. Here's how they work and how to use them—page 22.

Continuing the series that resulted in Electronic Musical Instruments, *Richard Dorf describes a new organ which exhibits design principals that reduce cost without sacrificing tone and performance. See page 25.*

WHAT'S ALL THIS ABOUT DAMPING?

HOW DO WE HEAR?

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SEPTEMBER, 1955 VOL. 39, No. 9
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AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

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AUDIO PATENTS

RICHARD H. DORF*

The idea of a "wireless microphone" is not new but a new patent of Robert L. Stephens (of the California firm well known to audio people) contains a rather nice design, and incidentally one which should be rather easy to experiment with. These gadgets—microphone-radio transmitter combinations designed to be concealed about the person—can be very useful in TV and motion pictures where without them a microphone boom must follow the performer all over. They have been particularly useful on Ed Murrow's "Person To Person" show where the living quarters of the people interviewed do not have the dimensions or shape of a barnlike TV studio and a boom would have to find itself changing shape like a python to keep in the right position.

The Stephens patent, No. 2,710,345, employs a simple 2-tube FM transmitter with a capacitor microphone[1, 2] connected directly across the oscillator tank for modulation.

The unit is in two main pieces plus a couple of wires. The general finished form is shown in *Fig.* 1. The transmitter fits in the left breast "handkerchief" pocket of a man's jacket and there is a pocket clip to keep it there. The microphone is permanently mounted on top of the case and faces the upper air behind a decorative handkerchief which conceals it. The battery case can go in the left jacket pocket. The antenna can go around the wearer's neck under his jacket collar and the battery cable, which also acts as a ground plane or counterpoise can go from pocket to pocket through holes in the jacket lining. The transmitter case can be brought down to around 1⅜ in. wide, 1¾ in. high (exclusive of microphone), and ⅝ in. thick. The battery case is somewhat larger, about 1½ in. wide, 2½ in. high, and ¾ in. thick. These dimensions are deduced from what the inventor says.

Figure 2 gives a complete schematic diagram of the unit with—happy day—all circuit values. Both tubes are subminiature 5672 pentodes. V_1 is the oscillator operating in the neighborhood of 25 mc. Its tank coil L_1 consists of 24 turns of No. 31 enamelled wire wound on a ¼-in. form with an adjustable powdered-iron core. The *only* capacitor across this coil is the microphone itself, which is fastened rigidly to the top of the case. With the values and frequencies given the mean microphone capacitance should be about 14 μμf for best L-C ratio. With normal sound pressures the capacitance changes enough to produce a deviation of around 1.5 kc each way.

V_2 is a frequency doubler, which gives an output of about 50 mc. Its tank coil L_2 is wound on the same iron-core form as L_1 and consists of 8½ turns of No. 24 enamelled wire with the antenna tap 1 turn from the B-plus end.

Note that the B-plus is grounded to the case rather than the B-minus as is customary. There are two reasons. First, this places the antenna and the microphone at ground potential for d.c. While a performer who touched antenna (or microphone) and case simultaneously with B-minus grounded would hardly be hurt by the available 60 volts, he might conceivably be surprised enough to speak a few unscheduled lines. Second, the radiation efficiency of the transmitter is increased by this connection.

The battery box contains two series-connected 30-volt batteries of the type used in hearing aids for a B-supply and a pair of 1½-volt batteries in parallel for the fila-

---

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

[1] Normally known to electronics people as a *condenser* microphone.—Ed.

[2] Who wants to be normal? Let's keep up with the times—after all, we know today that condensers are used only in steam engines!—Author

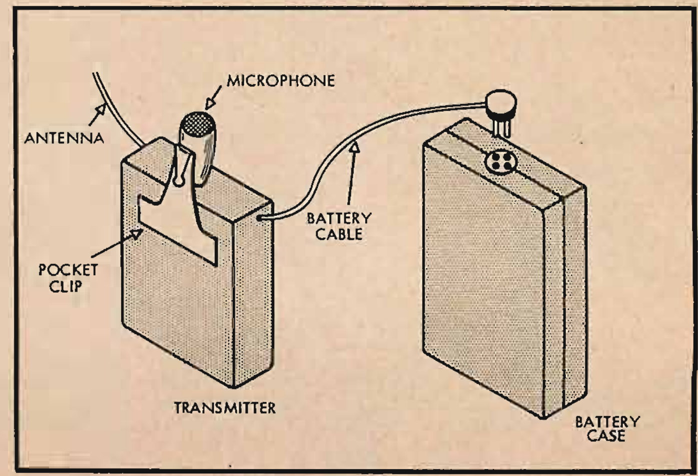

Fig. 1

that condensers are used only in steam
hearing aids for a B-supply and a pair of
1½-volt batteries in parallel for the fila-

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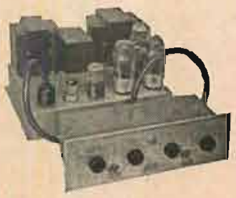

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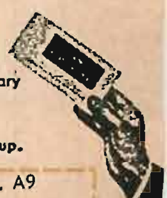

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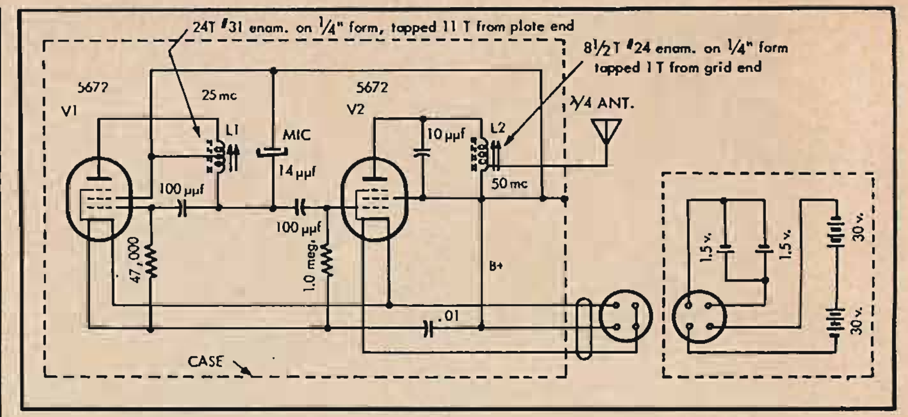


Fig. 2

ments. When the battery cable is plugged in the negative side of the 60 volts and the positive side of the filament supply are paralleled in the transmitter by the strap across pins 3 and 4 of the plug to provide the combined filament and plate return. The small hearing-aid batteries will operate the unit for 1 to 2 hours, while a larger set, for instance a portable radio battery, will keep it going 15 to 20 hours. The latter can be used where concealment is not important. The antenna should be a quarter wave at the operating frequency, which means in the vicinity of 55 in. at 50 mc. It can be draped around the body in whatever way is convenient.

It seems that a unit like this would not be hard to put together and would prove very useful for other purposes than TV and movie work—public address, radio, and concealed in a pot of flowers when you want to hear what your "friends" really think of you.

The deviation produced at the output is on the order of plus and minus 3 kc. While ordinary FM receivers do not go down to 50 mc, many of the prewar ones do, and it should not be hard to make or modify one for the purpose.

Quiet Volume Control

Volume-control potentiometers, even the best, eventually become noisy because of imperfect contact between moving arm and resistance element. While this is not of the highest importance in ordinary audio devices, it becomes a bad problem in electronic organs because the volume control is used so often in the course of playing.

Solomon Heytow and Richard H. Peterson of Chicago have patented a volume control in which this problem is eliminated and a couple of additional advantages are afforded. The circuit is diagrammed in *Fig.* 3. The patent number is 2,712,040.

The essence of the invention is a pair of voltage-sensitive resistors (thermistors) R_1 and R_2, used in a voltage-divider arrangement. Signal goes from the plate of the tube through R_1, the series leg, and R_2, the shunt leg of a voltage divider. Output is taken from the junction of the two through blocking capacitor C_3; C_2 is another blocking capacitor, and both are large so as not to affect the signal.

R_2 is a thermistor whose resistance value can be controlled by the current through it; the larger the current the lower the resistance. The audio signal is not large enough to cause any appreciable resistance change, and the thermistor is controlled by a d.c. source.

Voltage from the control source is fed through a divider consisting of R_7 and rheostat R_8. R_6 is mentioned in the patent as part of the divider but does not appear to have any useful purpose, so it is suggested that experimenters dispense with it. The controlled voltage at the junction of R_7 and R_8 is applied through a cascaded pair of time-constant networks R_5-C_5 and R_4-C_4 to the two thermistors R_2 and R_3. Since C_4 has a large value, the two thermistors are effectively in parallel to ground for signal. As the potentiometer arm nears ground, control voltage across R_2 and R_3 increases as does the current through them, and their resistances decrease, thus lowering the output signal level.

The first advantage of this device is that noise in the rheostat R_8 is not transmitted to the signal circuit because the two time constants are too long. In fact, R_8 can be a switch or series of contacts with as few as six finite resistance steps; the time constants will still cause a smooth change in signal level. Second, the control R_8 can be located as far away from the signal circuits as desired, without any effect on them. And a third, rather incidental advantage is that the value of C_2 can be chosen so that as signal level decreases, the bass does not decrease as much as the middles and highs, giving a loudness control effect which is very important in organs.

The inventors point out that since thermistors respond instantaneously to changes in current, considerable audio distortion would take place if the audio current were large enough to control thermistor resistance. They then say that this is effectively

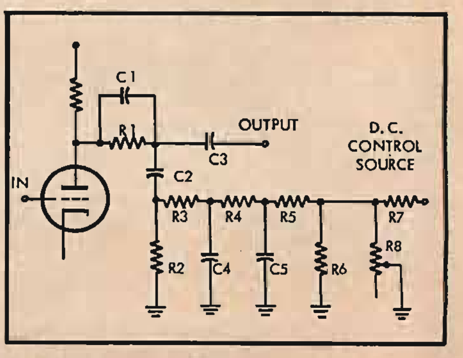


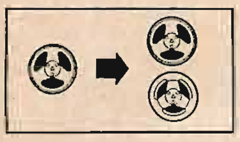
Fig. 3

highest importance in ordinary audio de-
very important in organs.
The inventors point out that since ther-

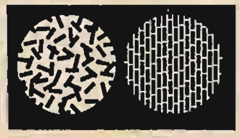
Now...record the *whole* performance... without a break!

YOU'LL GET EVERY NOTE of your favorite concert broadcast, sports event or dramatic program when you put it on new "Scotch" Brand Extra Play Magnetic Tape 190. Half as thick as conventional tapes but made with strength to spare, new Extra Play tape offers *50% more recording time* on a standard size reel. Thus, annoying interruptions for reel change are reduced to a minimum.

"Scotch" Brand's exclusive new oxide dispersion process gives you more brilliant sound, too. By packing fine-grain oxide particles into a neat, thin pattern, "Scotch" Brand has been able to produce a super-sensitive, high-potency magnetic recording surface on Extra Play Magnetic Tape. Hear the difference yourself. Try new "Scotch" Brand Extra Play Magnetic Tape 190 on your machine *today*.



EXTRA-THIN. 50% thinner, more potent oxide coating, 30% thinner backing permit more 190 Tape to be wound on standard-size reel. Result: one roll of new tape does job of 1½ reels of ordinary tape.



ELECTRON PHOTO microscope shows the difference! At left, artist's conception of view of old-style oxide coating. At right, "SCOTCH" Brand's new dispersion process lays oxide in neat, fine-grain pattern.

REG. U.S. PAT. OFF.
SCOTCH BRAND *Extra Play* **Magnetic Tape 190**

The term "SCOTCH" and the plaid design are registered trademarks for Magnetic Tape made in U.S.A. by MINNESOTA MINING AND MFG. CO., St. Paul 6, Minn. Export Sales Office: 99 Park Avenue, New York 16, N.Y. 3M COMPANY

Extra Play tape offers 50% more recording time on a on Extra Play Magnetic Tape. Hear the difference

obviated by using two thermistors of matched characteristics; this writer does not see how that would be useful. However, they also state—and this is obviously true—that the trick is to keep the d.c. control voltage very much greater than the signal voltage across the thermistors—between 20 and 100 times as high. This, of course, will do the trick.

The patent also shows how to make the circuit work as a volume compressor. If interested, you can get a copy of this as well as any other patent from The Commissioner of Patents, Washington 25, D. C., for 25 cents.

Audio Fair—AES Event Set For Mid-October

More exhibitors will participate in the 1955 Audio Fair than have ever before taken part in a public display of high fidelity equipment. Such was the announcement of Harry N. Reizes, Fair manager, on August 25, who reported that, with more than a month yet remaining for exhibitors to engage display suites, the numbers of executed contracts on hand was considerably greater than the total for any previous Fair.

As in years past the Fair will occupy the fifth, sixth, seventh and eighth floors of the Hotel New Yorker. The Fair will open on Thursday, October 13, and will continue for four days. Exhibit hours are 1 P.M. to 10 P.M. with the exception of Sunday, October 16, when the Fair will open at 12 noon and close at 6 P.M.

In keeping with the policy established with the first Audio Fair, the 1955 event will be open free to all interested parties, professional and amateur alike.

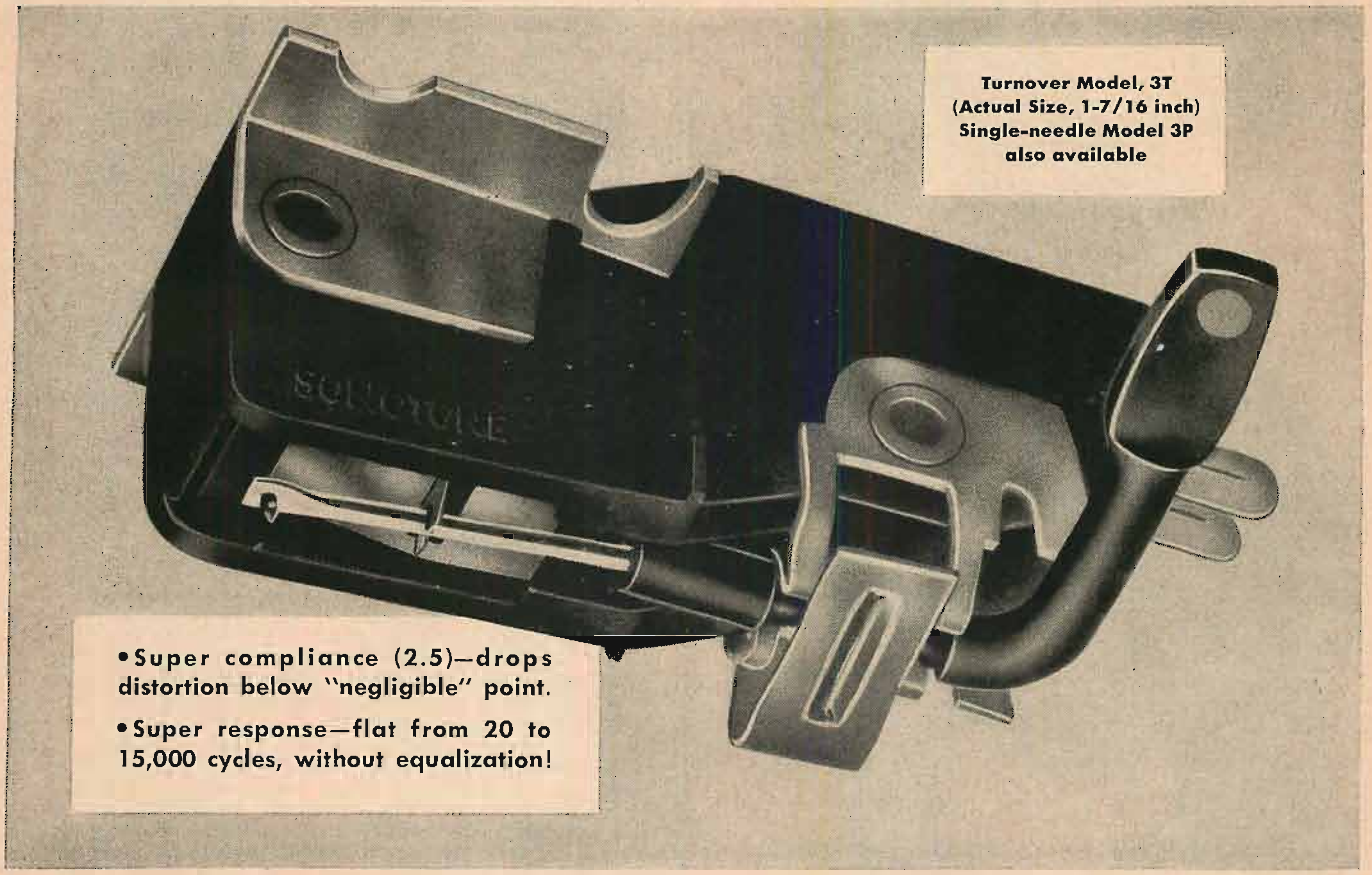
Sponsored each year by the Audio Engineering Society, the Fair is held in conjunction with the Society's annual convention. "Practicality" will be the theme of the 1955 convention, according to Col. Richard H. Ranger, program chairman. Included on the technical program will be panel discussions on transistors, amplifier design, and tape recording. Their purpose will be to bring out the correct and practical manner for handling each type of equipment. The agenda will also include theoretical and scientific papers.

The Society's annual banquet is scheduled for the evening of October 12 in the New Yorker's Grand Ballroom.

chairman. Included on the technical pro-

First Announcement!

New Sonotone "3" Series SUPER-FIDELITY Ceramic Cartridges



PARDON US IF WE CALL THEM "REVOLUTIONARY"...

but these new cartridges *obsolete* pre-amplifiers, equalizers, and old-style pickups!

If you've followed the development of ceramic cartridges since Sonotone pioneered them in 1946, you know we've made enormous advances.

Recently Sonotone has offered ceramic cartridges equal, by test, to most velocity types. Now, Sonotone presents the "3" Series, which set utterly *new* standards of finest performance, by all the measurements engineers know how to make. And your ears will confirm their findings.

But that's not all the story. The performance of these new cartridges makes the *inherent* advantages of the ceramic type loom larger than ever. Consider:

WHY A PRE-AMP?

There is only one reason for a pre-amplifier—a velocity pickup puts out too feeble a voltage to drive your amplifier directly. But these Sonotone "3" Series cartridges deliver a whopping 0.5 volts—roughly 50 times as much as most velocity types. So you can *eliminate* the circuitry, noise, space and expense a pre-amp involves. (If you now have a pre-amp, our simple adaptor permits immediate use of Sonotone "3" Series cartridges in your present system.)

WHY EQUALIZE?

Velocity type cartridges play back the various recording curves far from flat. So you need equalization for acceptable results. This means looking up the curve for each record, setting a knob before each play. Sonotone "3" Series cartridges end this nuisance—because ceramics don't respond to velocity, of needle movement, but to *amount* of movement. Result, they self-equalize—play back all curves so close to flat that the need for an equalizer disappears. Out goes more circuitry!

That still isn't all. These new cartridges eliminate magnetic hum problems. Laugh at heat and humidity. Fit any arm in wide use. Have the easiest of needle replacements. And the cost—?

Single needle model, with diamond, only **$30 LIST.** Turnover model with sapphire-diamond needles, **$32.50 LIST.** Less with sapphires. So even the price is revolutionary, when you're buying the ultimate.

NEW SONOTONE AMPLIFIER

We built this HFA-100 to realize the full excellence of Super-Fidelity ceramics. There's nothing to match this amplifier for beauty—musically and visually. Hum, noise and distortion are virtually unmeasurable—at maximum settings, distortion is only 0.15%! Cabinetry is superb solid walnut or solid mahogany, with solid brushed brass panel. **$117.50 NET.** Similar control unit, for use with power amplifier, **$59 NET.**

"Revolutionary" is a big word. But these Sonotone developments are pretty big news, too, we feel. We hope you'll look into them. If you like *music*, here's for you!

SONOTONE
CORPORATION, ELMSFORD, N. Y.

them in 1946, you know we've made enormous advances.
WHY EQUALIZE?
excellence of Super-Fidelity ceramics.
There's nothing to match this amplifier for

LETTERS

A Rebuttal?

SIR:

I have read with much interest your editorial entitled "Judge for Yourself" in the June issue and the subsequent editorial in the July issue, and I cannot take issue with some of your statements. I quite agree that there is equipment on the market labeled high fidelity which does not have good performance.

I would like to comment on one slant which I seem to detect in the editorial, and that is an apparent assumption that those who make components are specialists and build quality, whereas all of the manufacturers who put similar components into beautiful furniture cabinets do not build quality.

This is an assumption which I am sure you know is untrue and is possibly not one which you intended should be drawn from your editorial.

While I am certain that your comments as to specialization could not be intended to apply to Magnavox, I would like to point out that we have specialized in the design and construction of good sound reproducing equipment for about 35 years, and if any company is entitled to be termed a specialist in this entire field, I believe that we are.

Insofar as our designs are concerned, I believe that we can prove to you that we have the engineering talent and ability to design at least as good basic components as any manufacturer in the field. Our Engineering Department is completely unhampered in regard to "building to a price."

This seems to be a misconception in this field, and no doubt there are companies which do build to a price. The Magnavox Engineering Department designs to the highest quality and the price is set afterwards.

We have no fear whatever of demonstrating our equipment with comparative separatively built high fidelity components, and in fact, have done so many times. Actually, we do it every day in our own laboratories since we are "honestly building to quality," as you put it.

An assumption that *all* component manufacturers build a quality product is also unwarranted. An example of this lies in a comparative demonstration which I witnessed a few moments ago in our laboratory. As might be expected, we buy all competitive equipment and give it quite sincere and honest tests especially since we are using these tests entirely for our own information. I was disappointed to see the performance curves of one of the most highly touted and expensive speaker systems on the market. I was simply appalled by the fact that above 10,000 cps its response is almost nonexistent, and yet this is a system which claims up to 20,000 cps smooth response. I was also amazed to find various peaks in its performance, one of which is very predominant at 60 cps, giving undue emphasis at that particular frequency. There was also almost no response at 40 cps.

I assure you that this was disappointing to us and also would like to mention that Magnavox in its own speaker systems used in our top instruments would not tolerate such response curves.

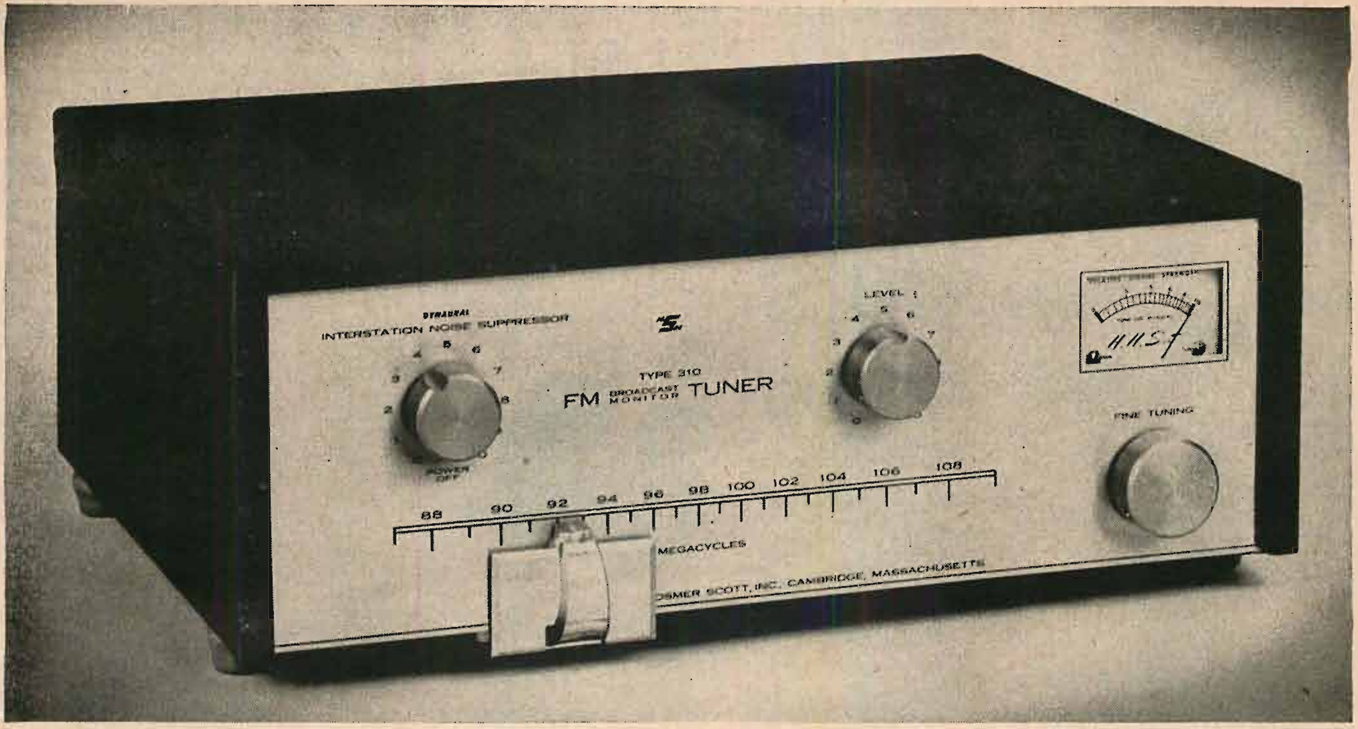
I do not intend this to be a critical letter and thoroughly agree with your conclusion that the purchaser should certainly hear everything and see everything on the market and judge for himself on the basis of performance.

Magnavox has adopted a policy of not making claims of specifications in advertising because of the simple premise that we have a very ethical policy of making only factual claims which sometimes can look bad in comparison with those whose claims do not seem to be governed by quite the same code of ethics. We have no quarrel whatever with the manufacturers of separate components and certainly agree that with proper selection and proper know-how fine systems can sometimes be put together in this way.

We do have a definite disagreement with a small group of component manufacturers who have apparently adopted a policy of misleading the public by claiming that the *only* way of obtaining high fidelity is to use separately purchased components. This is basically a fallacy as is the statement that all the engineering and design, know-how and honest efforts to build to high quality are confined to individual component manufacturers. It is only logical to conclude that the best over-all performance can only be obtained by the use of quality designed and built components which are specifically designed to operate with each other at an optimum. Any manufacturer building only one or two components of a complete system must recognize that his product will be used with many different makes and types of other necessary components in a system, and this being the case, must design and build a compromise rather than an optimum.

This being the case, the component manufacturers who wish to break out of the rather *small hobby market* and sell to the general public have a choice of two alternatives. The first of these is to continue to build products which are unmatched with

ever, the 6550 will provide full pover output with approximately the same grid voltage drive as the other tubes.
fications in advertising because of the simple premise that we have a very ethical policy of making only factual claims which



THE 310 FM TUNER

"...seems as close to perfection as is practical at this time." HIGH FIDELITY July, 1955

Here's why top audio experts agree that the 310 FM Tuner gives you performance found in no other tuner.

Very high sensitivity, combined with excellent rejection of noise and interference, makes distant stations sound as good as the locals. HIGH FIDELITY (July, 1955) says: ". . . sensitivity is extremely high; we haven't worked with any tuner that was better in this respect."

Now you can hear stations you never knew were there. For the first time, you can easily separate stations that are so close to each other on the dial they can't even be found with conventional tuners. Exceptional I.F. selectivity is the key to this unusual performance.

Radically New Wide-band Design

New *wide-band* circuits — the latest development in FM tuner design — make weak or strong stations tune alike. The wide-band design gives drift-free performance that removes all need for A.F.C. There is never the danger of weak signals being pulled out of tune by a strong nearby signal, which often happens when A.F.C. is used. And the wide-band design, combined with the use of silver-plated chassis, assures that strong local signals *do not* appear at more than one point on the dial.

The automatic gain control continuously and automatically adjusts for best performance, no matter how much the signal strength may vary. The A.G.C. also prevents distortion from overloading by strong local signals.

Fast Single-sweep Tuning

Single-sweep tuning lets you select any station in an instant — no more tedious knob twisting. A vernier control, together with a combined signal strength and tuning meter, permits critical tuning for very weak signals.

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**H. H. SCOTT Inc. 385 Putnam Ave.
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by *H. H. Scott*

key to this unusual performance.
". . . the 310 has everything. We can't think of any change

other elements in the system with which they will be used, which can only be a compromise. The second alternative is to have their jobbers put together packages and cabinets which to some extent, at least, are an attempt at a matched system. This second alternative brings these manufacturers completely around the circle to the point where they are providing what amounts to complete systems contained in a furniture cabinet. This is a disagreeable alternative, since it is in direct conflict with their highly vocal claim that *only* by putting together individual components can you obtain high fidelity, and that such systems cannot be satisfactorily contained in one cabinet.

Since the first alternative definitely limits the market to those who are interested in a more or less do-it-yourself hobby, and the second is completely inconsistent with one of their principal claims, this constitutes the horns of a rather serious dilemma.

Most people do not care to become combination acoustical and electronic engineers in order to play phonograph records, nor is it necessary that they do so, any more than it is necessary to take a mechanical engineering course in order to drive an automobile. In the infancy of the automobile business as well as the radio *business*, a great many people had a lot of fun putting elements together with varying degrees of success, but as the industries grew up these practices became less and less general.

The public has complete confidence in the reliability and integrity of leading companies in any industry. This confidence has been justified over many years of serving the public truthfully, honestly and sincerely with quality products.

It is only reasonable to assume that the same pattern will be followed in the high fidelity industry, and that the general public will be willing to allow trained and skilled engineers to take care of the necessary design work to produce the perfection of performance which they can judge entirely by their own listening pleasure.

Insofar as your comments on the Magnavox guarantee* are concerned, I would like to briefly mention that Magnavox has been in business for almost 40 years and in all this time has always meant every word of every guarantee they made and has lived up to every statement and guarantee. This policy certainly includes the challenging guarantee made in our editorial ad "Facts and Fiction of High Fidelity" to which you refer in your July editorial.

THE MAGNAVOX COMPANY
R. H. G. Mathews,
Director High Fidelity Division,
Fort Wayne, Indiana.

The Distaff Speaks

SIRS:

I have unfortunately just gotten a hold of the May issue of Audio. Therefore my belated remarks.

While my husband did do most of the installing of the components of our hi-fi system, I am perfectly capable of operating the "confusing knobs and dials." On the other hand, my husband (who incidentally drives the "shiftless" car while I stick by a standard transmission) is deathly afraid to handle the controls on the dishwasher or twirl the many knobs on our new oven. Perhaps Albert Preisman would like to try. And if he managed that hurdle, I would still challenge him on regenerating a water softener, getting a garbage disposer to go backwards, or maybe just threading a sewing machine.

I'm sorry that Eleanor Edwards, in the same issue, inclines to the belief that hi-fi starts out as the man's idea.

Etta Linton, San Diego 5, Calif.

(**Note: No company names were mentioned in either June or July editorial.* ED.)

shift characteristics and extended high frequency response. A new type balancing circuit makes

The Distaff Speaks

FIDELITY G EFFICIENCY

Especially...

where SPACE is LIMITED

What can be said for the Axiette among high quality loudspeakers generally, is one thing. But, more significant is the fact that the Axiette has become the ideal solution to the limited space problem . . . and who hasn't such a problem!

Many would-be high fidelity enthusiasts have been discouraged by the lack of available space. While there are smaller tuners and amplifiers, little has been done to relieve the speaker situation. Most smaller speakers and enclosures don't quite have 'what it takes' for good high fidelity systems.

The little Axiette has changed this. Used in a suitable enclosure and operating at normal living room volume, it is doubtful whether a group of critical listeners could consistently distinguish between the 8-inch Axiette and a costlier, larger system. This listening quality has never before been achieved in a loudspeaker of such small proportions.

If you are being denied the enjoyment of high fidelity because of space limitations, you have the answer in the Goodmans Axiette . . . ***the good little speaker that was designed to be heard — not seen.***

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EDITOR'S REPORT

THE AUDIO SEASON

For more reasons than one we shall be glad for the Fall season to commence this year. And for the first time in seven years the prime reason is not that the audio season commences—although just as sure as the leaves start to turn, ears seem to develop a greater interest in music and good sound reproduction. This year, of course, the principal reason is that Summer is over—this being the Summer we'll remember as long as the blizzard of '88 because of its unending hot spell. But then we don't *have* to live where it is hot, you may say.

But this year *does* portend well for the audiofan—there are more shows, equipment continues to be improved, records are getting better, and controls are becoming more simplified. By the time this is read, the WESCON show will be in the past; in Chicago, San Francisco, and Berkeley they will be readying their exhibits for this month (see Coming Events, page 62). People in New York will probably slow down their buying slightly until they see what is forthcoming at the biggest show—The Audio Fair—although we could never understand why they should wait once the urge is upon them since every distributor of audio equipment has his own audio show every day. These shows may be smaller—there may not be more than one of each kind of equipment—and they are certainly quieter, but they serve the same purpose, and the sales personnel can devote more time to each listener.

Then after New York comes Boston and after Boston comes Philadelphia. Also comes Mexico City—of which more next month since we shall have a preliminary looksee at this one on our way back from WESCON—on the same days as the City of Brotherly Love, so if you *must* go to an Audio Show on November 4, 5, or 6, you will have two to pick from. Then Montreal, Los Angeles, Washington, the IRE Show (in which audio is outclassed in numbers, at least), and the Parts Show where next year's products will be unveiled. Then the Music Manufacturers' show and we're right in the middle of Summer again. There's no rest for the audio manufacturer, if we may paraphrase a better known expression.

One event we look forward to with relish is old hat to our London friends, since they have already had two of these affairs while we haven't had any so far. We're speaking of the demonstration lecture and concert at Carnegie Hall the Sunday preceding the Audio Fair—October 9—presented by Gilbert Briggs, in collaboration with P. J. Walker and Columbia Records. Presenting recordings and live artists who made the recordings on the same program must have taken a considerable amount of intestinal fortitude the first time in London Festival Hall, even though he had been through the same type of demonstration several times before, both in England and Toronto. We missed all of them however, for much as we like Mr. Briggs, we must confess that our desire to attend was not matched by Pan-American Airways' desire to have us attend, so we stayed away. But we won't stay away from this one, and we expect it to be well worth hearing.

The "live" artists—who will also be heard recorded—are E. Power Biggs, Leonid Hambro, John DeLancie (oboe), and members of the Philadelphia Orchestra and the Philadelphia Woodwind Quintet. This seems to provide a wide range of tone qualities for comparison between reproduced sound and "the real thing," and should be most enlightening. But remember—Carnegie Hall is only so big—get your tickets early, either at the box office or at sound departments of most of the New York jobbers.

A TECHNICAL TOPIC

One of our readers—Dan Peacock, of the Bronx—calls attention to the practice of equalizing levels in demonstration rooms so that switching between speakers can be done without favoring one or the other—everyone knows that when two speakers are compared side by side, the one that is louder always sounds "better." His complaint has some merit, and is well worth discussion.

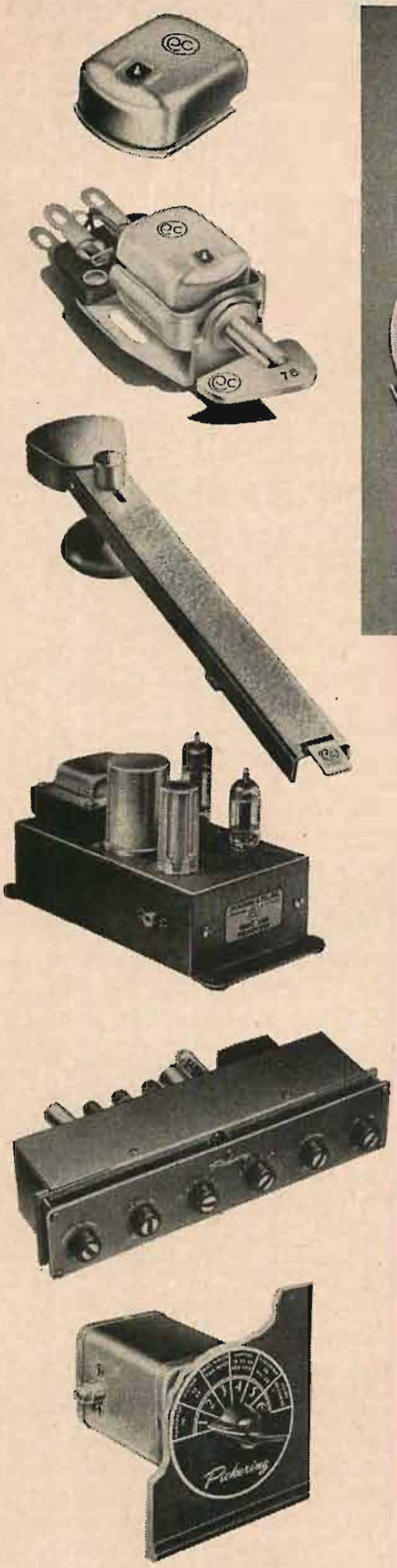
To begin with, let us be fair to both speaker and amplifier. There is some advantage to efficiency, no doubt, for one unit with an efficiency of 10 per cent will put out as much sound from a 10 watt amplifier as a speaker with only 5 per cent efficiency can put out from a 20-watt amplifier. That is pure arithmetic. But there are still some speakers of low efficiency which are capable of really fine reproduction, and one should not judge a speaker on efficiency alone. After all, when one builds a loudspeaker mechanism he finds the first model has peaks and valleys in it. To make the reproduction smooth, he must flatten it out, but he does this by cutting off the peaks rather than by filling up the valleys. And as he does so, efficiency goes down. It might almost be said that the speaker with the least efficiency is most likely to be the smoothest.

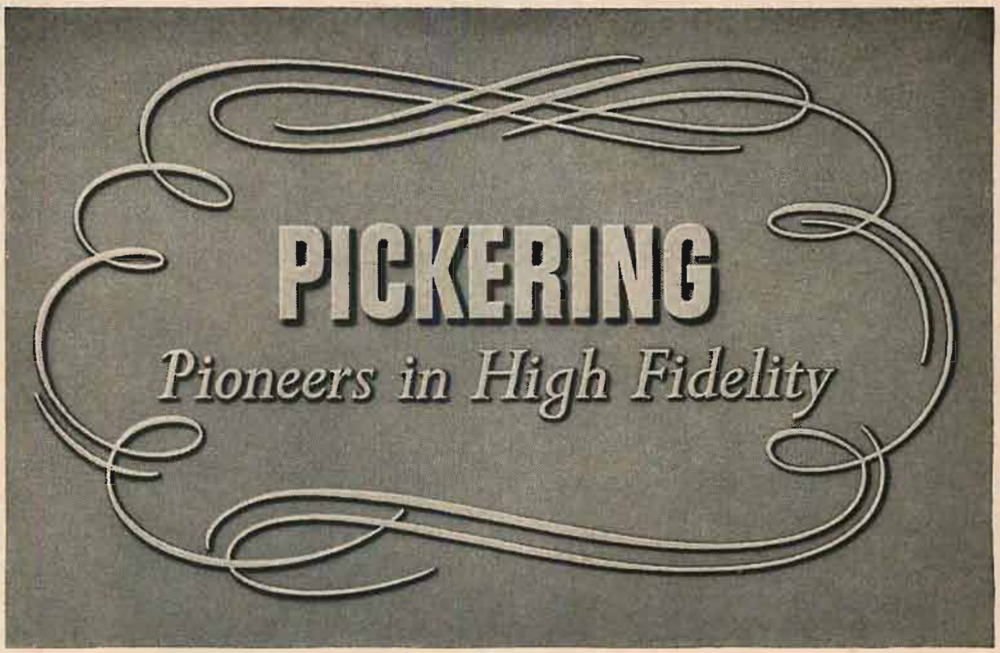
But it isn't fair to either amplifier or speaker to place the level-equalizing control in the voice-coil circuit, for this eliminates the damping factor of the amplifier as an influence in the total reproduction and it is likely to disturb the transient response. Thus if one likes the sound of an amplifier-speaker combination under conditions where a pad was used in the voice-coil circuit, he might find an entirely different kind of reproduction when he got the two of them home and hooked them up without the pad. And if the pad does degrade quality, it puts the more efficient speaker at a disadvantage, since the pad practically cancels out the effect of the amplifier's damping factor.

The cure? Place the level-equalizing controls between the source and the amplifier—switching controls and speakers simultaneously. This is not as simple as placing a pad in the voice-coil circuit, but it is more correct from the engineering standpoint and it will give the listener a true basis upon which to form his opinion of the performance.

After all, comparing audio equipment is not like a horse race, and the method of handicapping might better be selected from some other sport—golf or bridge, perhaps.

Music Manufacturers' show and we're right in the mid- for this eliminates the damping factor of the amplifier





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If you want the *best* that high fidelity can offer . . . if you are willing to invest just a *little* more to get a *lot* more listening pleasure, now is the time to ask your dealer for a demonstration with Pickering components. See if you, too, don't *hear* the difference!

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that every component comes up to the high standards expected of
Pickering equipment

NEW LITERATURE

• **Triad Transformer Corporation,** 4055 Redwood Ave., Venice, Calif., in Catalog TR-55, lists and illustrates a new group of high-fidelity output transformers with screen taps in the primary, providing extended range and increased power for modern amplifier circuits. Copy of the booklet will be mailed on written request. **S-1**

• **Specific Products,** 14515 Dickens St., Sherman Oaks, Calif., will mail free a copy of a paper of unusual interest titled "Using Standard Time and Frequency Broadcasts." Described in its entirety is daily broadcast cycle of standard-frequency stations WWV and WWVH, operated by the Central Radio Propagation Laboratory of the National Bureau of Standards. In addition to outlining use of the broadcasts as time standards, the 4-page pamphlet describes methods of using them for calibration of audio test equipment and for tuning musical instruments. Requests for copy should specify Bulletin G-2. **S-2**

• **Munston Manufacturing & Service, Inc.,** Beech St., Islip, N. Y., has recently published an informative 28-page booklet describing the firm's engineering and production facilities for a wide range of electro-mechanical products. Many of these products are shown in illustrations of radio equipment, communications components, and specialized types of electronic test instruments. One section of the booklet details services rendered to the government and private industry in the fields of advanced electrical and electronic engineering. **S-3**

• **North Electric Company,** Galion, Ohio, in a 4-page Bulletin AF-554, describes and pictures the firm's new low-cost signaling system designed specifically to fill the expanding need for multi-channel sub-audio or d.c. signaling equipment. The system utilizes either frequency-shift or frequency modulation for transmission. It permits teletype, telegraph, telemetering, and other sub-audio or d.c. signaling to be multiplexed over open wire, telephone carrier, radio, microwave, or any other system capable of carrying voice frequencies. **S-4**

• **Weston Electrical Instrument Corporation,** 614 Frelinghuysen Ave., Newark 5, N. J., in new Catalog A46A, illustrates and fully describes the extensive line of Weston laboratory standard instruments and standard cells. Also included is expanded information on frequency coverage, frequency compensation and waveform effect pertaining to the widely used Model 326 voltmeters, ammeters, and wattmeters. Copy of Catalog A46A is available free on request. **S-5**

• **Automatic Electric Sales Corporation,** 1033 W. Van Buren St., Chicago 7, Ill., will mail on request a new 4-page catalog describing the complete Automatic Electric line of control components for industrial application. Equipment listed includes stepping switches, relays and key switches. Descriptive matter covers the functions, specifications, and an illustration of each relay and switch. When writing ask for Circular 1843. **S-6**

• **Fine Hardwoods Association,** American Furniture Mart, 666 Lake Shore Drive, Chicago 11, Ill., serves both industry and consumers with an informative 16-page booklet titled "Know Your Hardwoods," which will be mailed free on request. Contained in the publication is a worthwhile discussion on the acoustical qualities of hardwood when used for hi-fi cabinetry. To increase understanding of the constructional features of bonded (plywood) furniture in terms of strength, beauty, design variety and price, there is incorporated in the booklet a special illustrated section which dispels the idea that "veneered" means a paper-thin sheet of wood merely "pasted" on the surface of a furniture piece, as with imitation grains. **S-7**

• **Electrosonic Specialties,** 7230 Clinton Road, Upper Darby 3, Pa. is offering manufacturers of background-music tapes free listings in the Fidelivox Recorded Tape Directory which will be distributed free to consumers. Tape producers should write for details describing the procedure to follow in getting their products listed: consumers, in writing, should request only that their names be placed on the directory mailing list. **S-8**

efficiency. In addition Redheads are designed for high output, are
track, and full track models.
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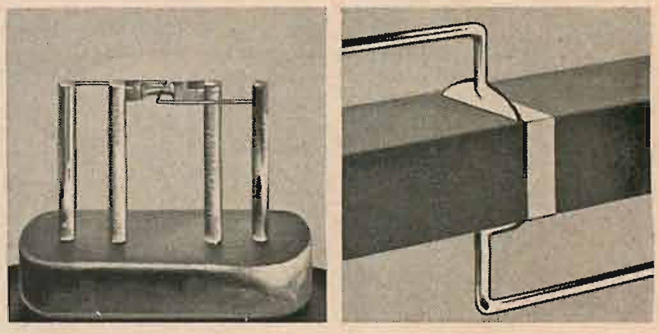
Bell Laboratories scientists, who invented the junction transistor, have now created an automatic device which performs the intricate operations required for the laboratory production of experimental model transistors.

It takes a bar of germanium little thicker than a hair and tests its electrical characteristics. Then, in steps of 1/20,000 of an inch, it automatically moves a fine wire along the bar in search of an invisible layer of positive germanium to which the wire must be connected. This layer may be as thin as 1/10,000 of an inch!

When the machine finds the layer, it orders a surge of current which bonds the wire to the bar. Then it welds the wire's other end to a binding post. Afterward, it flips the bar over and does the same job with another wire on the opposite side!

Once only the most skilled technicians could do this work, and even their practiced hands became fatigued. This development demonstrates again how Bell Telephone Laboratories scientists work in every area of telephony to make service better.



Transistor made by new machine is shown in sketch at left above, magnified 6 times. At right is sketch of area where wires are bonded. The wires are 2/1000 inch in diameter, with ends crimped to reduce thickness.

BELL TELEPHONE LABORATORIES

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS FOR CREATIVE MEN IN MECHANICAL ENGINEERING

hair and tests its electrical characteristics. Then, in

What's All This About Damping?

N. H. CROWHURST*

An engineering discussion of the elements entering into the effects of variable damping in an amplifier when the loudspeaker itself cannot be complemented accurately and completely.

In recent months, much has been written about variable damping, ultimate damping, and various aspects of damping—principally concerning its application to the coupling between an amplifier and a loudspeaker. In an endeavor to clarify the general understanding of this subject, let us consider what damping means in a somewhat broader sense.

Let's start, for example, with damping as applied to musical instruments, where electronics does not enter into the picture at all. When a piano string is struck by the piano hammer, it continues to vibrate for a considerable period, especially if the check action is held off by holding the piano key down. This indicates that the Q of the resonant system is very high. It's true that considerable sound energy is radiated, but in comparison with the energy stored in the vibrating string the radiation is small because this energy is not radiated directly from the piano string.

In illustration of this fact, the writer well remembers listening to a piano which was not provided with the regular sounding board. This piano has been designed for use with electronic pickups, so the quality of sound could be entirely under electronic control. When this piano was played without the amplifier switched on, its music could only be heard by putting the ear close to the instrument. Just sitting in the same room with the piano, one would imagine that the musician was pretending to play it rather than actually depressing the keys. This shows that in the normal type of piano the principal radiation of sound comes from the sounding board, to which it is transmitted from the strings' supports.

Having realized this fact, consider how the vibration of the piano string may be damped. Application of damping to the sounding board has very little effect. It may be possible, applying some damping material to the sounding board, to considerably reduce the radiation of sound, but it will not materially damp the vibration of the string. On the other hand application of the felt provided on the check action of the piano to the string itself, will damp the vibration of the string almost instantly. Touching the string with the finger while it is vibrating will also damp its vibration quite rapidly.

A number of other musical instruments could be similarly discussed. The principal things that we can learn from a consideration of these phenomena are two. First, a large surface is required to radiate sound into the air, because only in this way can satisfactory acoustic matching between the vibrating medium and the air load be achieved; a small vibrating element such as a string does not move the air, it rather cuts through it. Second to produce satisfactory damping, the damping agent must be applied at a suitable point sufficiently close to the vibrating medium itself. Although the vibrating medium is coupled to some extent to the sounding board, damping of the sounding board can only damp the movement of the string to the same extent as it is coupled to it. Because the coupling is what we would term in radio very loose, the damping that can be effected in this manner is extremely small.

Before turning to the discussion of loudspeakers and their damping, let us consider briefly two other analogies that will prove useful in helping to visualize the various components that make up our problem.

The first is a transmission line. A transmission line has a characteristic impedance. If the line is terminated by its correct matching impedance all the transmitted energy is absorbed when it reaches the receiving end, but if the line is not correctly matched some of the energy is reflected and travels back along the line. Correct matching of the transmission line can be considered as correct damping, because it will prevent reflections from occuring.

The other analogy that we can consider is a transformer. The particular properties with which we are concerned are the primary inductance and the leakage inductances of the transformer, together with the secondary winding capacitance. For simplicity we will consider the transformer to be of 1:1 ratio. *Figure* 1 shows the equivalent circuit of a transformer, with the elements in which we are interested shown. The transformer can be a resonant circuit in several ways. The primary inductance can resonate with some capacitance in the primary circuit; similarly the same relative inductance can be resonated in the secondary; or the combined inductance can be resonated with capacitance part of which is in the primary and part in the secondary. All of these resonances are of the same basic type in which the inductance element being resonated is the primary inductance, but it is also possible to resonate the leakage inductance between primary and secondary with a capacitance either in the primary or secondary.

Consider the particular case of leakage inductance resonating with capacitance in the secondary circuit. Although the capacitance is physically connected in parallel with the transformer secondary winding its effect is very different from a similar capacitance connected in parallel with the primary winding. Short circuiting of the primary will result in maximum Q of the tuned circuit, because any resistance in series with the primary appears virtually as resistance in series with the tuned circuit. This is illustrated in *Fig.* 2. This kind of resonant circuit can be damped with either a resistance in shunt with the secondary winding, which provides shunt damping for the tuned circuit, or a resistance in series with the primary winding which provides series damping for the resonant circuit.

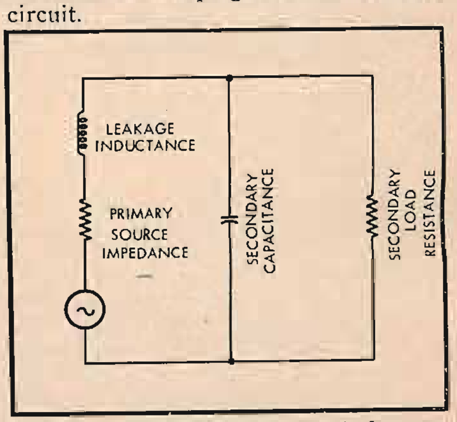


Fig. 2. Rearranged equivalent circuit for resonance between leakage inductance and secondary capacitance.

* *150-46 18th Ave., Whitestone 57, N. Y.*

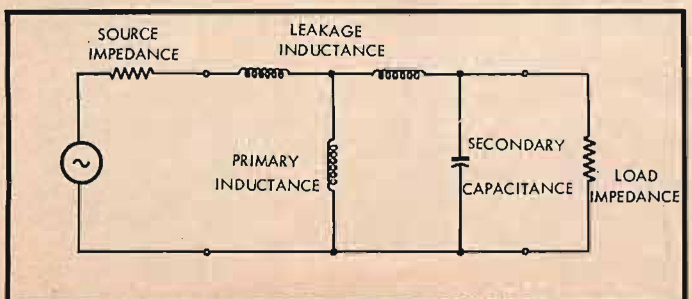


Fig. 1. Equivalent circuit of a transformer, to show possible resonances. For convenience the transformer is assumed to have 1:1 ratio.

ports. Having realized this fact, consider its correct matching impedance all the which provides shunt damping for the

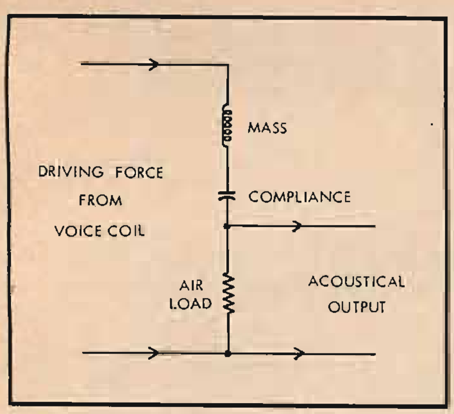


Fig. 3. Simplified equivalent circuit of acoustical action of a loudspeaker.

In this respect a transformer can be considered as somewhat similar to a quarter wavelength of transmission line, when the transmission line to which we referred previously is incorrectly terminated. If the termination value is too high, at a distance back along the line equivalent to a quarter wavelength of the frequency being transmitted the reflected impedance becomes the inverse of the terminating impedance, using the characteristic impedance as a mean.

Back along the line at consecutive quarter wavelength intervals, the impedance will change alternately between one that is high and one that is low compared with the characteristic impedance. Similarly, if the termination instead of being incorrect in resistive value is incorrect by being a reactance instead of a resistance, the apparent impedance measured at quarter-wavelength intervals back along the line will alternate between inductive and capacitive reactance.

If the line is loss-free, which corresponds with high Q conditions in a mechanical arrangement, then this transfer of impedance will go on indefinitely at quarter-wavelength intervals, without changing the relative magnitude of impedance at each half-wavelength interval. But practical lines introduce a certain amount of electrical loss, and for this reason each alternation away from the characteristic impedance of the line deviates by a decreasing amount from this value, and after a sufficiently long length of line, the measured impedance will become sensibly equal to the characteristic impedance. However, in such a line the loss becomes considerable and a relatively small amount of the transmitted energy will reach the receiving end.

The Loudspeaker

Having briefly discussed some of the analogies we can apply, now let's turn to the consideration of a loudspeaker. Basically, what we are concerned with in a loudspeaker is driving a column of air which communicates with the room so as to recreate a desired sound field.

Let us first consider the acoustical arrangement that achieves this. It consists of a loudspeaker diaphragm in contact with the air in front of it (which communicates with the room) and also with the air behind it which is contained in the loudspeaker enclosure.

This can constitute a resonant system which can be analyzed by using the same mechanical terms for the elements of a resonant system as would be applicable to a vibrating piano string. The mass of this resonant system consists of the mass of the moving diaphragm and the voice coil attached to it, together with the mass of the small quantity of air adjacent to it, which can be regarded as having to move with it. The compliance consists of the compliance of the diaphragm surround and also the compliance of the centering spider, if one is used, together with the compliance of the air inside the enclosure behind the diaphragm. This latter will act basically as a compliance rather like the air inside a Helmholtz resonator. These are the reactive elements of the resonant system. The resistance elements provide damping and prevent it from having a natural vibration of its own in a well designed system. These are the viscosity of the air in the enclosure, the viscosity in the compliance of the surround and centering spider, and the radiation resistance coupled to the diaphragm by means of the air load which it drives to radiate energy into the room.

So far we have just considered an acoustical resonant system. Now we come back a stage further, to consider a mechanical-acoustical relationship. This rather corresponds—but in different proportions—with relationship between the vibrating piano string and the sounding board. The piano string is the basic driving force, but the sounding board is the element that radiates sound energy into the air. Similarly in a loudspeaker, the voice coil is the basic driving force but the diaphragm is the element that radiates the sound into the air. So the coupling between the voice coil and the diaphragm has to be considered as part of a loudspeaker system.

In the preceding discussion we considered the voice coil as if it were rigidly coupled with the diaphragm, but this idea ignores the fact that the diaphragm has to be constructed of some material which cannot be absolutely rigid. The diaphragm material itself has mass and compliance distributed over its entire surface area, and hence all parts of the diaphragm do not have to vibrate in an exactly similar manner.

This means that the diaphragm can behave somewhat after the fashion of a transmission line. A driving force is applied at the voice coil end of the diaphragm and is transmitted outwards toward the periphery where the surround is located. It's true that at the lower frequencies the time taken for the wave to be transmitted this distance corresponds with a small fraction of a wave period. But at higher frequencies an appreciable fraction of a wavelength is involved and various cancellation effects can arise which interfere with the frequency response of the loudspeaker.

For this reason a loudspeaker of good design has the surround viscously damped, either by choice of suitable configuration for the surround, or by application of some impregnation which will have the desired effect. This will prevent such cancellation effects due to transmission of sound waves to and fro radially in the diaphragm itself before they get transmitted to the air in contact with it.

There is another fashion in which the diaphragm can set up resonances of its own—by setting up local vibration patterns similar to Chladni figures in a vibrating plate. At higher frequencies the coupling of the air load to the diaphragm improves, and for this reason it is easier for the diaphragm to vibrate in a complex manner than to follow the driving force as a single element. In this case the diaphragm does not have to move as much air, because parts of it will be traveling inwards while the other parts are traveling outwards; this enables the air to oscillate sideways across the surface of the diaphragm instead of having to drive in and out as a single large mass.

These break-up resonances again depend upon the characteristic mass and compliance of the material of which the diaphragm is made. They can, however, be minimized by attention to the construction of the diaphragm, by the introduction of circular reinforcing indentations into the material, and by other means. However, as regards our damping feature, the important thing to notice is this: these resonances occur in the diaphragm material itself and cannot logically be damped out either by acoustical damping in the enclosure or by some form of damping in the voice-coil circuit, because they take place between the driving force provided by the voice coil and the loading force provided by the air. Nothing beyond these limits can affect the behavior of the break-ups.

Resonances

We have now considered the behavior of a loudspeaker, from the air column that it has to drive into the room back to the voice coil, which so far we have considered merely as a driving force. The basic resonance at this point consists of the mass of the diaphragm with all its appurtenances and some of the air which moves with it, together with the compliance of the surround and of the air in the enclosure, acting as a single resonant arrangement.

The natural frequency of this resonance is usually somewhere between 35 and 125 cps, varying according to the particular design of loudspeaker and the size and type of enclosure used. This is the resonance about which designers are concerned when they talk about damping applied in amplifiers. It should be noted that this is not necessarily the only resonance in a loudspeaker, but it is the principal one.

We now come to the point where the transformer analogy is useful. The voice coil and the loudspeaker magnet system constitute an electro-mechanical coupling unit, the purpose of which is to transfer electrical energy from the amplifier into energy in the voice coil.

This part of a loudspeaker is essentially similar in basic principles to an

deviates by a decreasing amount from this value, and after a sufficiently long
diaphragm material itself has mass and compliance distributed over its entire
which moves with it, together with the compliance of the surround and of the

fibers connecting to the brain (*Fig.* 3).

Recent Work

Fortified by this background of research, Helmholtz in 1857 presented for the first time his theory on resonance hearing. As Professor of Physiology at the University of Bonn, he was presenting lectures on the scientific foundations of music. From these lectures, during a period of six years, he built up the foundation of his world-famous theory as expressed in his work "Sensations of Tone" ("Die Lehre von den Tonempfindungen"). Very briefly, Helmholtz's theory was as follows: he conceived a series of progressively tuned resonators in the ear, with the high pitched tones at the apex. This action was compared to the action of piano strings with the dampers raised, singing a note into the opened frame will cause strings to vibrate in accordance with the frequencies contained within the sound emitted. In his conception of the resonance theory Helmholtz felt that the pillars of Corti were the resonators of the hearing system, serving as the intermediate agents between the auditory nerve endings and the resonant fibers of the basilar membrane. A basic concept herein contained is that the frequency discriminability of the ear is directly concerned with the number of active elements (resonators).

Received at first with great enthusiasm, Helmholtz's theory has fallen in favor through the years and now must contend with several alternative theories for consideration. The most radical departure in theory stems from consideration of pitch perception and discrimination in a manner differing from that of Helmholtz whose method, classified as the Place Theory, demands a spatial distribution of response in the cochlea, i.e., for every tone in a sound, there is a particular location and of course, a particular group of nerve fibers. Contrasted to this theory is that of the Frequency Theory which states that the auditory nerve receives a signal from *all* hair cells and transmits the signal in the form of electrical signals to the brain. An early exponent of this theory was Rutherford who first presented his ideas in 1886. His name and theory still claim the attention of investigators.

Frequency Theory

Outstanding in the Frequency Theory grouping are the theories advanced by Meyer (1898) and Wrightson (1876). It is not possible to present either theory fully because of space limitations, consequently only a brief synopsis follows:

In preparing the foundations for his theory, Meyer points out that exponents of the "Place Theories" admit[1] . . . "that any 'tuning' by resonance or otherwise could only be very 'broad' so that the ear for discrimination must have a neural ability to tell *which* of *many* cochlea points responding to the same frequency responds with greater amplitude than any other. Wever has calculated[2] that, without a further hypothesis covering this matter, ". . . in the middle pitch-region two frequencies heard in succession should then be just discriminable if the interval is a quarter of an octave. All music would be impossible . . ." Wever concisely describes[3] Meyer's theory as follows: ". . . When the stapes moves inward and exerts a positive pressure on the cochlear fluid, the response of the basilar membrane is at first restricted to its most basal portion. This part of the membrane is bulged downward, and the bulging continues until the limit of free motion is reached, and then it begins to spread to the more remote portions. The bulge extends in the apical direction only as far as necessary to give room to the fluid displaced by the stapes.

"When the stapes reaches its most inward position and starts backward it causes a second displacement of fluid, but in a direction contrary to the first. Consequently, the membrane is drawn upward. This reversed motion of the membrane, like the other, begins at the basal end of the cochlea and spreads toward the apex. If the backward movement of the stapes has the same amplitude and velocity as the preceding forward movement, this second movement of the membrane extends the same distance as the first and exactly erases the original bulge; the membrane then is in its initial position. If the reverse stapedial movement is somewhat less in amplitude, the second displacement of the membrane will erase the first only in the basal region and the most apical part of the original bulge will remain undisturbed.

"The distance of spread of a displacement depends not only on the amplitude of the stapedial movement but also, to a degree, on its velocity . . . .

"Excitation of the hair cells probably ocurs on the upward phase of every up-and-down cycle displacement . . .

"The loudness of the sound is determined by the extent of the spreading

(*Continued on page 57*)

[1] Meyer, The hydraulic theory of the cochlea and comparative anatomy. *Am. J. Psychol.*—April 1952—65—No. 2, p. 289.

[2] Wever, Status of auditory theory. *J. Acous. Soc. Am.*—May 1951—23—No. 3, p. 288.

[3] Wever, Theory of Hearing. Wiley, 1949 —pp. 83–84. Permission to quote gratefully acknowledged.

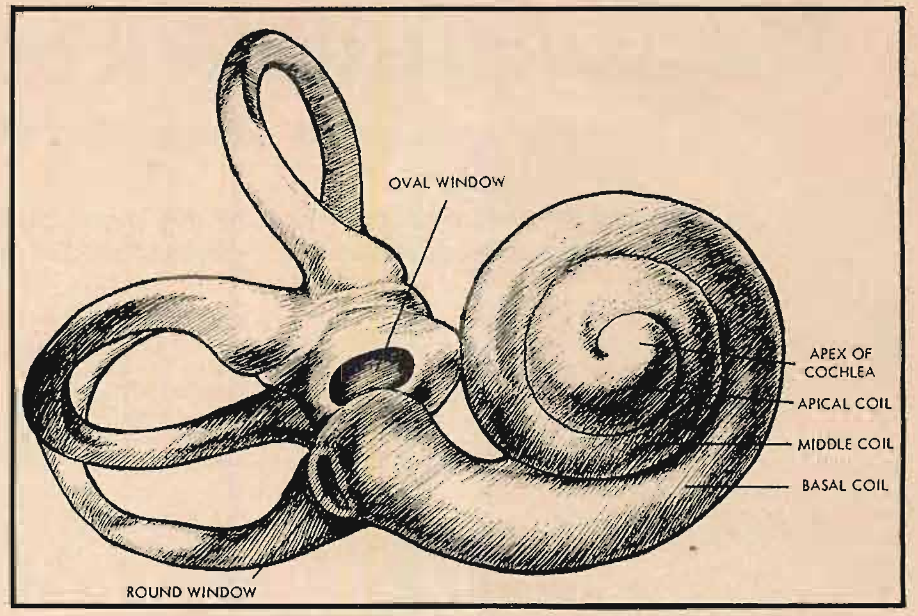


Fig. 2. A front view of the bony labyrinth.

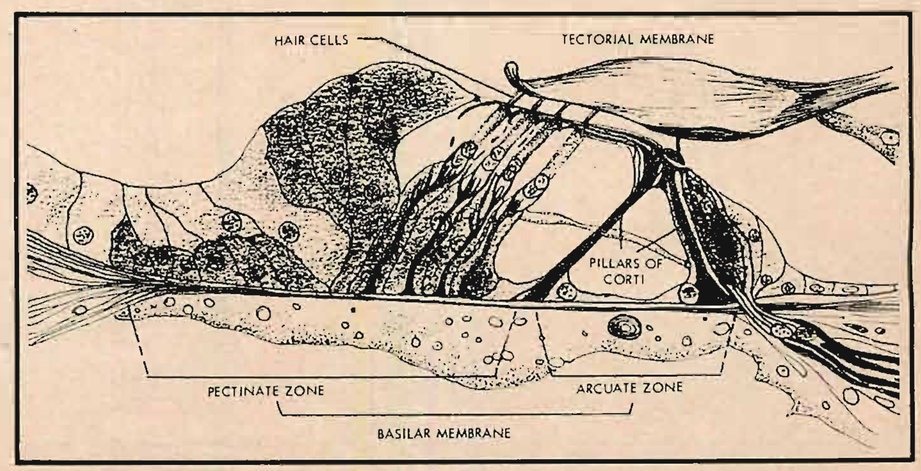


Fig. 3. Cross-sectional view through the Organ of Corti at the middle coil of the cochlea.

ideas in 1886. His name and theory still claim the attention of investigators
—pp. 83–84. Permission to quote gratefully acknowledged.
mined by the extent of the spreading (*Continued on page 57*)

The Electrostatic Loudspeaker

LLOYD J. BOBB and EDWIN C. GULICK*

Construction and characteristics of the new capacitance-type high-frequency loudspeaker developed by Philco and used in the company's receivers.

During the past 30 years there has been continuing progress in the art of recording and reproducing music and speech with the ultimate goal the ability to recreate the original performance with complete fidelity. The satisfactory utilization of the whole audio range in these processes depends on providing a chain of low-distortion equipment starting with the recording microphone and extending through the recording and reproducing equipment to the loudspeaker. Where any part of this chain introduces distortion, the use of extended-range reproducing equipment often produces sounds less pleasing than can be obtained from the use of a more limited range. But where the whole chain maintains the lowest possible distortion level, the utilization of the full audio range is mandatory for the best approximation of the original performance.

While there has been significant progress in the development of the electronic and electroacoustical components, the greater portion of this 30-year span has been characterized by a dearth of wide-range program material for home reproduction. Economics rather than technology has restricted the frequency range of most network broadcasts. The reverse was more or less the case for phonograph recordings. Most home listeners in the past have preferred to restrict the high-frequency response of their playback equipment rather than endure the high surface noise and distortion which was particularly irritating in the upper registers.

In very recent years recording equipment and techniques have been developed sufficiently to permit mass production of phonograph records for home use with coverage of essentially the whole audio spectrum at very low distortion and surface noise levels. Reawakening interest in FM broadcasting in this, the video era, is due in some measure to the wealth of excellent program material available to broadcasters in the new recordings. The current availability of prerecorded magnetic tape for home as well as broadcast use adds another source of low-distortion program material.

For most listeners, the limiting factor has shifted once more to the playback equipment. The component development lagging most significantly has been the loudspeaker, particularly in reproduction of the upper registers of the audio range. The industry has had some success in extending the upper frequency response of single dynamic speakers. However, the use of a single speaker to cover the whole audio range brings with it a prevalent, though little discussed, type of distortion. This is a Doppler-type modulation whose value is dependent on the frequencies being reproduced.

Better results are obtained when multiple speakers are used, each optimized for a particular portion of the range. Horn-loaded tweeters are capable of good high-frequency performance, but satisfactory units of this type are often somewhat expensive. Less expensive substitutes in the form of small dynamic cone tweeters have been used. The cone tweeter does represent some advance over larger conventional dynamic loudspeakers as far as the relative efficiency in radiation of high-frequency acoustic power is concerned, since the mass of the moving system is somewhat lower. Nonetheless, it is still substantial, being about 2 or 3 grams. At the higher audio frequencies, it becomes increasingly difficult to move the vibrating system at the desired velocities.

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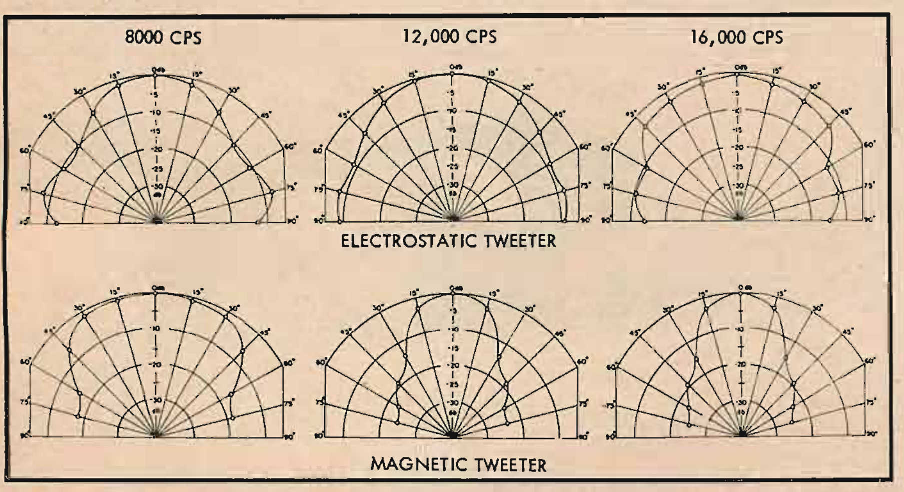

Fig. 2. Polar graphs show the directivity of the electrostatic tweeter contrasted with that of a conventional horn-loaded dynamic tweeter at three frequencies within the range of both.

The Electrostatic Speaker

Very recently another type of high-frequency loudspeaker has appeared in commercial production both in this country and abroad. This is the electrostatic loudspeaker, long recognized as a unit capable of excellent transient characteristics because of the very small moving mass and the distributed driving force. However, over 25 years of investigation had failed to develop an electrostatic speaker as a successful production item. Recently a form of the electrostatic speaker capable of mass production at a modest price was developed in the laboratories of Philco Corporation. This speaker has been incorporated in the new models of Philco's "high-fidelity" phonographs.

The failure of the electrostatic speaker to emerge as a commercial item in the past can probably be ascribed to two factors. Materials available for the diaphragm or membrane and the insulation have deteriorated too rapidly for incorporation in production equipment. Further, proponents of the electrostatic speaker have endeavored to cover the whole audio spectrum with a single unit.

The development of modern plastics has overcome the first handicap. Durable membrane materials, high in area-to-mass ratio, are now available. Plastics of desirable electrical insulation characteristics are on the market. The two desirable characteristics are combined in a new polyester membrane material.

The second handicap has been overcome with the realization that more effective results could be secured by multiple speaker units. Electrostatic loudspeakers operate most efficiently with closely spaced electrodes so that large excursions of the moving elements are not profitable. As a result, where attempts have been made to cover the lower audio registers, substantial areas have been used, areas measured in square feet. Such loudspeakers are exceedingly directive when reproducing higher frequencies. However, when the electrostatic loudspeaker is used in conjunction with a suitable dynamic loudspeaker which covers the lower and mid-ranges, the electrostatic speaker may be made quite small. By appropriate design, excellent polar distribution is possible.

The principles of operation of the electrostatic speaker have long been known. Professor Hunt's recent book contains an excellent discussion of the

* Research Division, Philco Corp., Philadelphia 34, Pa.
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The second handicap has been over-

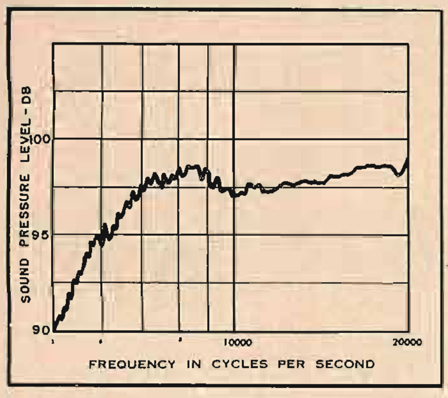


Fig. 4. Sound pressure response of the tweeter with a 30-volt signal and 300-volt d.c. bias.

subject.[1] Electrically, the electrostatic loudspeaker is essentially a capacitor, perhaps not a very good capacitor, since one of its electrodes may vibrate within certain constraints in response to the applied signal. This introduces a resistive component permitting work to be performed, in this instance, the production of acoustic power. Physically the unit consists of a fixed electrode, commonly called the backplate, and the vibrating electrode known as the membrane or diaphragm.

Both electrodes must be conductive, of course, so that if the vibrating element is an insulating plastic, it must be rendered conductive by the application of conductive material. The backplate must approach acoustic transparency at the lowest frequencies to be reproduced, in order not to increase the stiffness of the system in the operating range.

Since the electrodes are close spaced and the membrane has a high compliance, constraints are usually provided to insure separation of the electrodes. These constraints may be in the form of small spacer pips or strips, or they may be compressible material. Additionally, the membrane is usually held under tension in such a manner as to keep it separated from the backplate and to provide a restoring force opposing displacement due to electrostatic forces.

[1] Hunt, "Electro Acoustics," John Wiley and Son, 1954.

The vibrating system is set in motion by the electrostatic forces existing between the two charged electrodes in accordance with Coulomb's Law. The charge existing on the electrodes arises from two sources: a steady charge due to a polarizing potential and, superimposed on this, a varying charge which is the signal. The steady charge serves to increase the efficiency and to minimize the generation of distortion. The acoustic output is a product function involving both the steady and varying potentials.

The use of distributed electrostatic forces eliminates certain factors which give rise to distortion generation in loudspeakers driven by electromagnetic forces. Cone breakup in a dynamic speaker arises when the cone is driven by the voice coil at a frequency near one of the many natural resonances of the vibrating system because the cone is set in motion by the application of forces applied only in the region of the apex of the cone. Corrington has given an excellent treatment of this phenomenon.[2] Analogous behavior cannot occur in the electrostatic speaker because the vibrating system is set in motion by the application of electrostatic forces which are equally distributed over the whole area of the vibrating system. It, therefore, moves everywhere in phase, and no subsidiary modes are possible.

The use of modern plastic materials, conductively coated, for the diaphragm or membrane provides a moving element whose mass is small. Negligible energy is stored in the moving system. Air damping is adequate to stop the motion rapidly when the driving signal has ceased. The transient behavior of the electrostatic speaker is excellent. Oscillographs of the acoustic output in response to short bursts of signal disclose that the electrostatic speaker has superior transient characteristics when compared to expensive horn-loaded high-frequency loudspeakers. Cone - type tweeters are a poor third.

[2] M. S. Corrington, "Transient testing of loudspeakers," Audio Engineering, Aug. 1950.

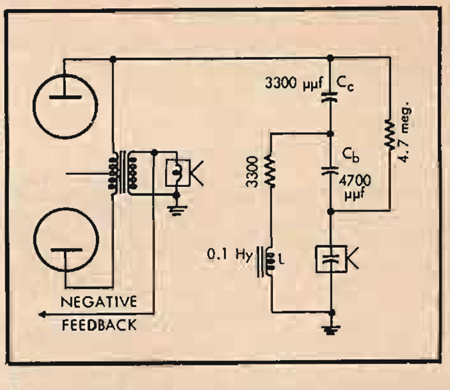


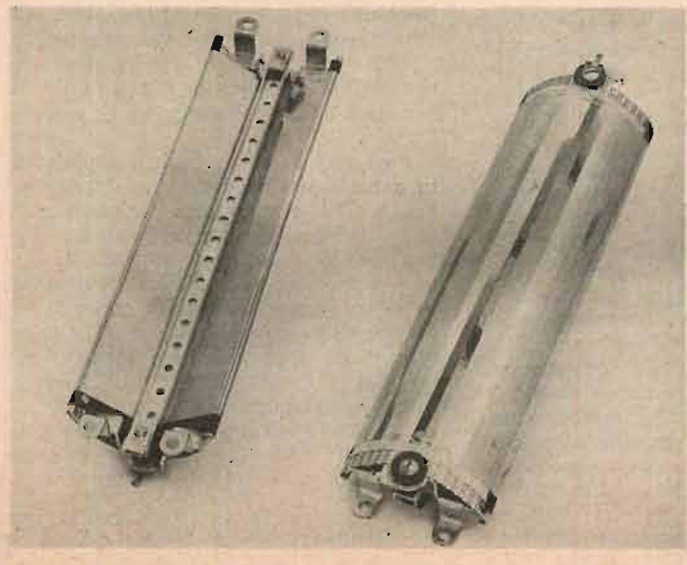
Fig. 5. Electrical circuitry shows method of connecting the speakers to the output stage.

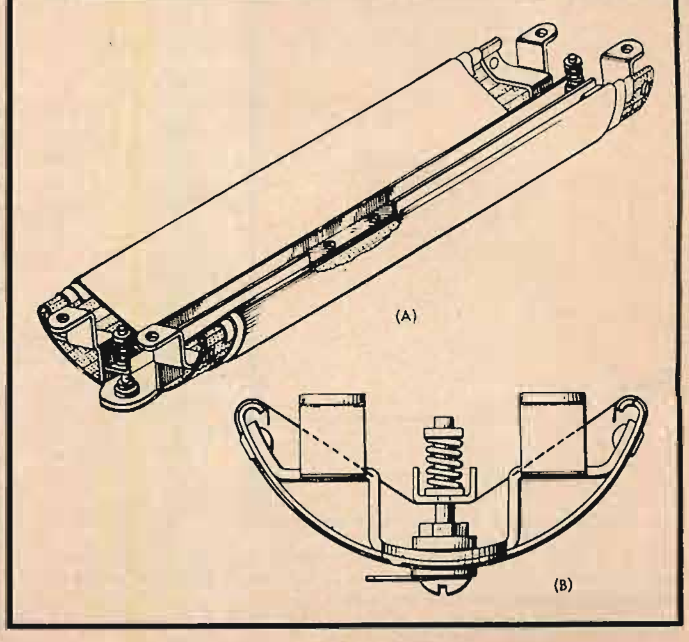
Construction

The electrostatic loudspeaker shown in *Fig.* 1 has several novel design features. One of the most significant is the semicylindrical form which accounts for its desirable field pattern. The speaker is mounted with the axis of the cylinder vertical. Acoustic energy is radiated quite uniformly in the horizontal plane but somewhat restricted in the vertical, corresponding to the requirements of ordinary home music systems.

Close examination of *Fig.* 1 will reveal that rather than being truly a semicylindrical surface, the speaker is actually formed of sixteen slender facets. This assembly approaches a true cylindrical section since the width dimension of each facet is small compared to the wavelength of the highest frequency of the audio range. Effectively, a cylindrical wave is generated. *Figure* 2 shows polar curves of the sound-pressure response

Fig. 1, (left.) Front and rear views of the new tweeter. Fig. 3, (right.) These cutaway views show how the vibrating element, formed as a sleeve, is placed over the semicylindrical backplate and brought to tension by spring loading.





tension by spring loading.

at several frequencies. Polar distribution of a magnetic horn tweeter is also shown for comparison.

The stationary electrode is perforated aluminum on which vertical ribs are formed. These ribs act as the spacers to provide separation between the fixed and vibrating electrodes. The active area of the loudspeaker is that of the narrow rectangles lying between these ribs. Mounting feet attached to the backplate serve also to stiffen the assembly.

The vibrating element is fabricated as a sleeve of conductively coated plastic material. This unique design overcomes the assembly problem of stretching the membrane uniformly over a rectangular or circular frame. The sleeve is placed over the semicylindrical backplate and brought to proper tension by the application of a spring-loaded pressure plate as shown in *Fig.* 3. This eliminates variations in tension that may result from a slightly uneven mounting surface and also protects against changes in the speaker's characteristics should there be same small cold flow of the plastic membrane material.

This membrane is a film of a new polyester plastic .0005 inch in thickness. It is rendered conductive by a vacuum depositing process which places an exceedingly thin layer of metal over one surface. The plastic is characterized by high mechanical stability as well as dielectric strength. These properties assure minimum mass of the moving element consistent with mechanical and electrical requirements. The total mass of the vibrating system is about 1/10 that of cone-type dynamic high-frequency loudspeakers and is sufficiently small that it has little effect at the highest frequency of interest. The mass reactance of the vibrating system is comparable to the radiation resistance at the upper end of the audio spectrum. *Figure* 4 shows the frequency response of the electrostatic speaker. It will be noted that there is no h.f. fall-off in the audio range.

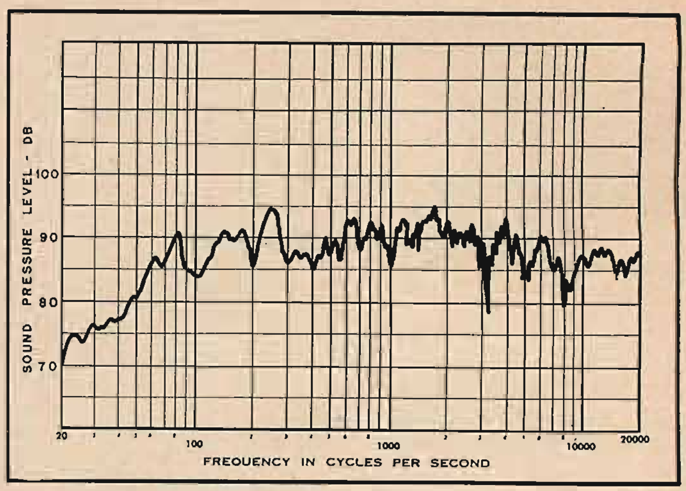


Fig. 8. Sound-pressure response of the phonograph of Fig. 7.

Fig. 7. A commercial table-model phonograph which includes the electrostatic tweeter.

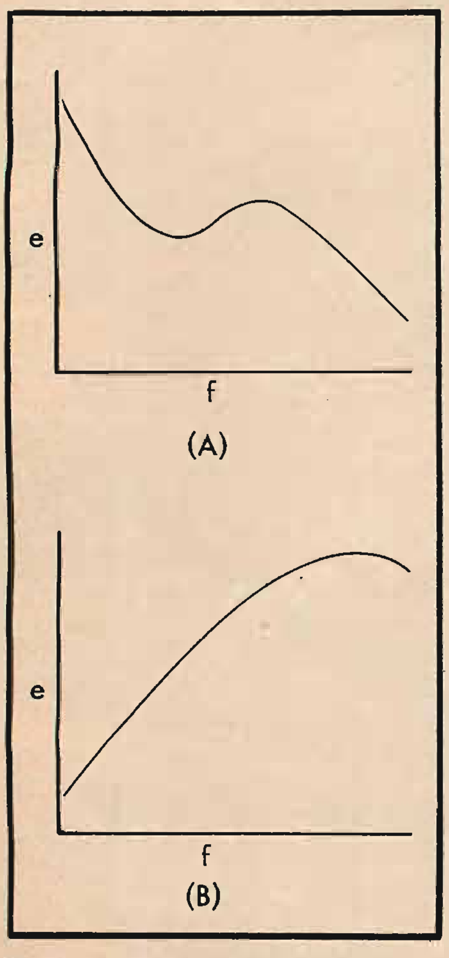


Fig. 6. Impedance looking into the electrostatic tweeter coupling network is shown in (A). In (B) curve shows signal voltage across speaker.

Employment

In application, the electrostatic loudspeaker is used in conjunction with a companion dynamic loudspeaker, the two units being driven by a conventional push-pull audio amplifier. The crossover frequency is about 7,000 cps. This frequency was chosen because there are available many types of curved-cone dynamic speakers which exhibit reasonable efficiency up to about 7,000 cps. Above this there is a natural fall-off in acoustic power developed so that no electrical cutoff network is required for the dynamic speaker. It should be noted that although some dynamic speakers will exhibit good axial response above the 7-kc figure, the total radiated power, as measured by integrating the sound field, falls rapidly above this frequency. The impedance of the dynamic loudspeaker in the upper registers is largely inductive and its magnitude rises with frequency. In the region of the crossover and above, it may be many times the optimum load for the amplifier.[3]

The equivalent circuit for the electrostatic loudspeaker is given by Hunt.[1] For the design of coupling networks, however, only the impedance presented by the static capacitance between the two electrodes need be considered. In the model described, this is about 3000 μμf.

The coupling circuit is shown in *Fig.* 5. The network alleviates capacitive loading effects of the speaker and at the same time prevents the electrostatic speaker and its network from loading the amplifier in the operating range of the dynamic speaker. The Q's of both the series and parallel resonances are kept to appropriately low values by the 33,000-ohm resistor. No deleterious effects from the connection to a single plate of the push-pull output stage have been noted. The polarizing potential is taken from either B+ or the plate terminal. C_B is required for blocking.

The impedance seen looking into the coupling network of the electrostatic speaker is shown in *Fig.* 6 (A). The minimum of the curve is due to the series resonance of the coupling capacitor and the inductance. The maximum is due to the parallel resonance of the inductance and the series combination of the speaker capacitance and that of the blocking capacitance. It will be noted that the network is effectively removed from the amplifier throughout the operating range of the dynamic speaker.

The signal voltage developed across the speaker is shown in *Fig.* 6 (B). The variation across the useful range is about 2 db.

Figure 7 shows a typical application in a mass-produced table-model phonograph. The electrostatic high-frequency unit is protected by a perforated plastic housing which does not appreciably disturb the polar distribution. The axial sound pressure curve with constant input signal is shown in *Fig.* 8. This curve was taken with the tone controls set for flat response. There is, however, some low-frequency compensation, accomplished by a tap on the volume control, to offset the low-frequency loss due to the small size of the enclosure.

[3] F. Langford-Smith, "Radiotron Designer's Handbook, 4th ed., 1952, p. 837.

the blocking capacitance. It will be noted
Employment
that the network is effectively removed

Fig. 1. The largest Minshall organ, Model LC, which has a chorus generator.

The New Minshall Organ

RICHARD H. DORF*

In Two Parts — Part I

A new approach to design details has produced an electronic organ with the kind of construction economy and performance standards that make for good engineering in any field.

It is a safe bet at this moment that the next product of the electronic art scheduled for a boom in the manner of radio, television, and high-fidelity sound is the electronic organ. The bet is safe because that boom has already begun, even though it is still just in its infancy and may never perhaps attain the proportions of the high-fidelity market. All of the companies in the field, principally occupied for years only with selling to churches, now make spinet and medium-sized organs for the home—and are selling them by the carload. Complete kits are becoming available for home construction of organs. And new companies, sensing the growing demand, are entering the field with new designs. The consumer is finding that an instrument with the ability to produce sustained tones with many different timbres is a fascinating and rewarding one to buy or build, and, as in so many industries before this one, his discovery is working a metamorphosis.

One of the principal problems which manufacturers of organs have is economy of design consistent with good performance. When the market was confined almost exclusively to churches this problem did not loom so large because churches, while most of them are by no means wealthy, can at least, in effect, pool the funds of many individuals to pay for an instrument. The home organ buyer, however, is using only his own money and now that he is an important customer prices must be scaled down. This is a problem because organs are inherently somewhat expensive. They must, for example, provide at least one separate tone generator for each of at least 60 notes, and this alone leads to volume consumption of tubes and other components.

One of the most economical and interesting designs is that of the Minshall electronic organ (made by Minshall Organ, Inc., Brattleboro, Vt.—formerly Minshall-Estey but now having no connection whatever with Estey). The Minshall tone generators employ only half a tube, 4 resistors, and 3 capacitors per note. Similar economies occur throughout the instrument. Yet it produces a great variety of tones which are imitative of pipe-organ sounds, and the organ is at home with music of any type from Bach to Basin Street.

The original all-electronic model of the Minshall is described in the writer's book, *Electronic Musical Instruments*. The company is one of the youngest in the field and this was its first commercial realization. Since then, however, a good deal of change has been made to overcome faults which extensive field reports brought to notice and to increase very greatly the quality and variety of tonal resources. In this article we shall see the organ and its components and point out improvements.

There are today four standard Minshall models. Top of the line is the LC shown in *Fig*. 1. This is a full 2-manual unit with 25-note pedal clavier. It is distinguished from the Model L, shown in *Fig*. 2, by the fact that the LC has a second 4-octave set of tone generators which may be tuned slightly sharp or flat of the main generator set and can be switched in to give a "celeste" effect. The two models are otherwise identical. *Figure* 3 shows the spinet Model S, which has two offset 44-note manuals and 13 pedals; the S has about the same registration as the larger models despite its smaller size and lower price, which makes it one of the most versatile spinets offered. The new Minshall Chord Organ

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

infancy and may never perhaps attain the proportions of the high-fidelity market. buyer, however, is using only his own money and now that he is an important come faults which extensive field reports brought to notice and to increase very

Fig. 2. Model L, described in this article.

is shown in *Fig*. 4. This is a single-manual unit with 48 keys. It may be played in the standard way, but for chord use ten chord buttons are provided. These are used with the lower-octave keys of the manual to produce ten chords in each of the 12 keys, 120 in all. In this article we shall describe the Model L in detail. All the other models are essentially similar except for the chord organ which would require a separate article.

Over-all Scheme

A simple block diagram in *Fig*. 5 gives a general idea of the layout of the organ sections. Each of 12 tone-generator chasses produces five notes separated by octaves, so that 60 notes are generated in all. These are wired to a key-switch assembly for each manual. Each key-switch assembly has three output busses,[1] one each for 4-, 8-, and 16-foot tones. Each bus goes to an amplifier, after which the tones are fed through tone filters. The original tones are roughly sawtooth in shape and contain considerable harmonics; the tone filters, selected by tablet switches, shape the tones to imitate various organ voices. The outputs of the filters are combined and fed through a preamplifier which incorporates the swell-shoe attenuator, after which the tones are amplified by a power amplifier and fed to a speaker. The speaker is contained in the console of the Chord Organ and the Model S; the larger models employ separate tone cabinets. The Model H, a one-manual organ which is being discontinued, also uses a self-contained speaker.

Tone Generators

The basic distinction of Minshall electronic organs has always been the tone-generator system, invented by George Hadden who is also responsible for other advances in the electronic music art. The basic circuit of this generator has been described fully in the writer's book and in other articles and the description will not be repeated here. The principal virtue of the circuit is that it is inexpensive and yet reliable.

The complete circuit of a tone-generator chassis appears in *Fig*. 6. Each of the frequency dividers requires only one-half of a 12AX7, with no transformers or other expensive components. The resistors and capacitors used are all standard 10 per cent tolerance components, none having to be specially selected except for R_1 through R_4. The frequency ranges over which a generator with one set of values will operate and divide properly is over half an octave. There are four dividers on a chassis, however, and the useful ranges overlap somewhat so that the total range for the chassis may possibly be less than five semitones. For this reason, the required total 12-semitone range for all the generators has been divided into four sub-ranges of three semitones each and four sets of values are used to cover the total. The values for these are all shown in *Fig*. 6.

Fig. 3. The spinet, Model S, has abbreviated manuals and pedals.

The master oscillator which may be tuned to set the organ in tune is a well designed Hartley. To allow for vibrato creation by variation of d.c. element voltages, the time constant of the grid-leak network R_7-C_3 has been made slightly smaller than would be required for optimum stability and an a.c. path has been added between plate supply and grid consisting of C_3 and R_6. When the plate supply voltage is varied at a rate between 5 and 8 cps, the frequency varies at the same rate. The use of the L-C oscillator is a part of the new models and is an improvement over the old design in which R-C phase-shift oscillators were used. The R-C oscillators tended to be somewhat unstable over a period of time because of change in tube plate resistance.

The frequency-divider stages are effectively voltage amplifiers in which the plate output is used to charge a capacitor between plate and cathode. The value of the capacitor is so chosen that it can charge only at a rate in the neighborhood of half the input frequency. The fundamental component of the plate voltage is then fed back to the grid in such phase as to cause the tube to cut off during every other input cycle; this causes the alternate positive peaks of the input wave to make the tube conduct and produce plate-current pulses at half the input frequency. The action, like that of most feedback systems, is hard to describe in a few words; complete details can be obtained elsewhere.

The plate output is the result of a capacitor which is charged and discharged,

Fig. 4. The Minshall Chord Organ, an active competitor of the Hammond for the tired - businessman market, may also be played without using the chord buttons.

[1] For explanations of the terms used in connection with organs, see the writer's book "Electronic Musical Instruments," Radio Magazines, Inc., P. O. Box 629, Mineola, N. Y., $7.50.

tained in the console of the Chord Organ
and the Model S; the larger models em-

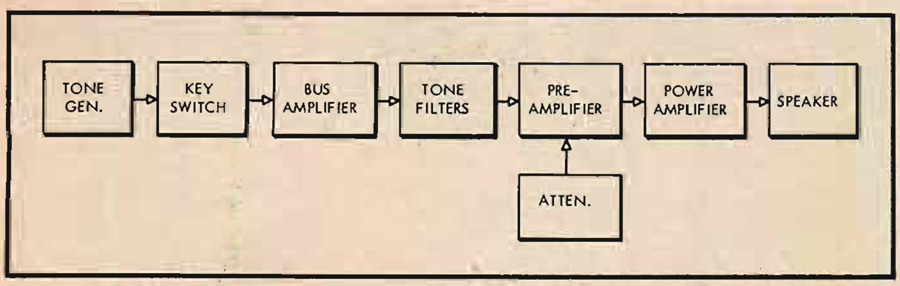


Fig. 5. Block diagram shows the essential sections of the Minshall.

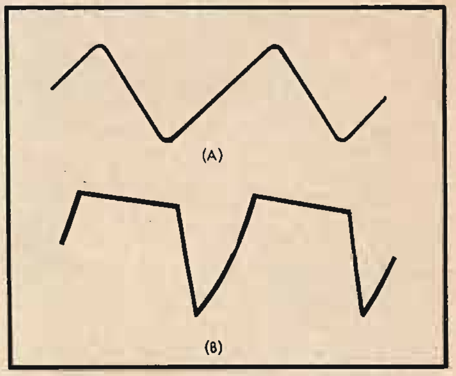


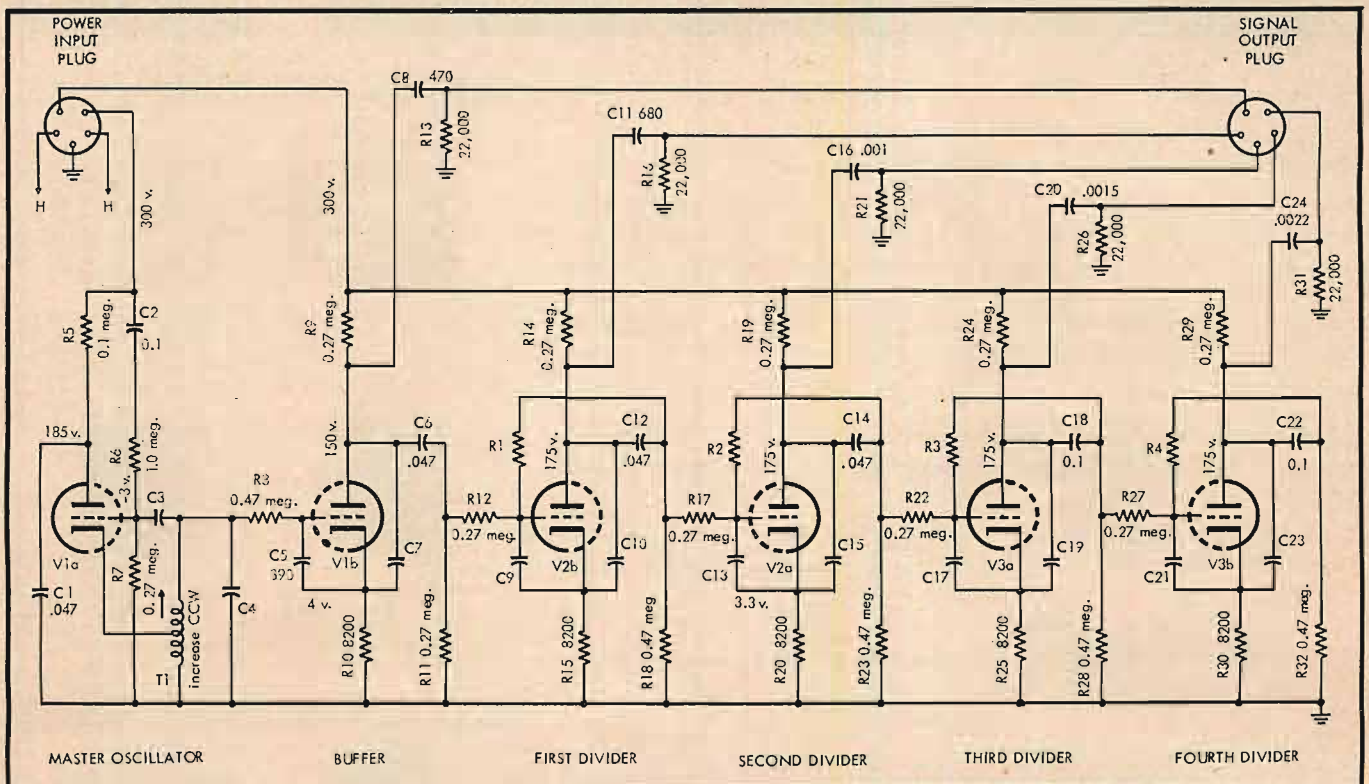
Fig. 7. Waveshape at (A) is that given by the generators proper. The shape at (B) has higher harmonic content and is obtained by differentiation.

and therefore takes the waveform of a sawtooth, as illustrated at (A) in *Fig. 7*. As can be seen, the flyback time of the sawtooth is quite large—at least 20 per cent—and the harmonic content is not very great. This was a fault in earlier models and made it imposible to secure any really bright tone qualities or, indeed, to have any really satisfactory variety of tone colors. In addition, the high-impedance key-switch system had to be of the shunt type because of leakage through the capacitance of open switches.

In the new circuit the plate outputs are not used directly. They are first passed through differentiators, which may be looked on as high-pass filters. They consist of C_8-R_{13}, C_{11}-R_{16}, etc., in *Fig. 6*. They have two functions. First and most important, they change the harmonic structure of the waves, making the harmonics much more prominent with respect to the fundamental, as may be seen in the resulting waveform of (B) in *Fig. 7*. With this improvement, the new models have very satisfactorily bright and interesting reeds and strings and a very good variety of colors. The second function, incidental but useful, is in voicing. By selection of the capacitor elements of the differentiators, the overall level of the higher notes is made greater than that of the lower ones. When all tones are passed through the later formant filters which are mostly of the low-pass type, the total scale tends to have more even loudness from top to bottom than if all incoming tones to the filters were of the same level. This is the same job done in the Baldwin organ by networks between octaves in the keying bus outputs and in the Schober Organ Kits by varying-value resistors in series with each key switch.

There are two additional improvements in the new Minshall generators. The first is that a cathode-bias resistor has been added in each divider stage. There is now less possibility than before that a change in some component or voltage will cause a misfunction, since an unbypassed cathode resistor tends to be a compensating factor, holding the tube at about the same operating point despite changes in other factors. The second improvement is that all the divider grids are direct-coupled. In the former design the grid impedances were extremely high and weather variations would sometimes cause trouble. The new arrange-

(*Continued on page 59*)



Resistors R1, R2, R3, R4 are factory selected. Approximate value 0.5 meg.

CAPACITOR VALUES DEPENDING UPON NOTE

NOTE	C3	C4	C7	C9	C10	C13	C15	C17	C19	C21	C23
C, C♯, D	.0033	.047	.01	.0047	.015	.01	.027	.018	.056	.039	.12
D♯, E, F	.0027	.039	.0082	.0039	.012	.0082	.022	.015	.047	.033	.1
F♯, G, G♯	.0022	.033	.0068	.0033	.01	.0068	.018	.012	.039	.027	.082
A, A♯, B	.0018	.027	.0056	.0027	.0082	.0056	.015	.01	.033	.022	.068

Fig. 6. The new tone generators are similar to the old ones but have several improvements.

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Individual room acoustics and the location of your speaker can adversely affect the fidelity achieved by the rest of your equipment.

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"COMPANIONETTE". Decorative and smartly styled. A compact, top quality loudspeaker system, ideal for use as an extension speaker.

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INSTITUTE OF HIGH FIDELITY MANUFACTURERS · INC ·

INSTITUTE of HIGH FIDELITY MANUFACTURERS

This is the first in a series of articles concerning the affairs of the Institute of High Fidelity Manufacturers insofar as they affect the public interest. As more material is made available, other articles will appear from time to time under the same masthead.

It has been said that most people know a good thing when they see it. The question arising in some quarters is whether these people are equally aware of a good thing when they *hear* it.

High fidelity has brought its problems as well as its blessings. The growing interest in high quality sound reproduction has stimulated the rapid growth of a new market for high fidelity equipment. This, in turn, has brought new manufacturers into the field and has encouraged some of the older ones to direct their attention to this category of products.

While activity in audio was limited to engineers and hobbyists, there was a fair likelihood of the buyer's ability to evaluate quality. But with the development of a general consumer market, a less informed buyer has come into being —more susceptible to claims and less qualified to substantiate the reliability of these claims.

The difficulty that has arisen is that some manufacturers are attempting to capitalize upon this susceptibility, by employing the magic import of the phrase "high fidelity" as a device to woo buyer acceptance. The phrase "high fidelity" has lost whatever reliable meaning it has ever had. It has become a promotional 'gimmick'—a sort of 'open sesame' to the new market—applied, in some instances, to products which hardly demonstrate the quality implied by the term.

Manufacturers of bona fide high fidelity equipment are disturbed by this state of affairs. Consumers, too, in many cases, have given voice to the need for clarification. Some have insisted upon the establishment of 'standards' as the basis for determining whether a piece of equipment might be properly termed—"high fidelity." Others have espoused the need, generally, for public education—guidance—as to what actually constitutes high quality sound reproduction.

Some course of action is certainly necessary if progress in this field is to continue, and if the public is to benefit from such progress. Because—unless people learn to know true quality and to recognize the masquerade for what it is, there will be nothing to justify and sustain the cost and effort of designing and producing ever better equipment.

Mindful of the need for action, a group of well known manufacturers in the field gathered together—and out of their deliberations was born—some 7 months ago—the Institute of High Fidelity Manufacturers. A perusal of its membership reads like the 'who's who' in the sound field:

Audiogersh Corp.
Altec Lansing Corporation
Ampex Corp.
Audak Company
Beam Instruments Corporation
David Bogen Co., Inc.
British Industries Corp.
Berlant Associates
Conrac, Inc.
Electro-Voice Inc.
Fisher Radio Corp.
Fairchild Recording Equipment Co.
G & H. Wood Products Co.
General Electric Company
Harman-Kardon, Inc.
James B. Lansing Sound Inc.
Klipsch & Associates
Karlson Associates Inc.
Presto Recording Corp.
John F. Rider, Pub.
Mark Simpson Mfg. Co., Inc.
Newcomb Audio Products Co.
Pilot Radio Corp.
Presto Recording
Rek-O-Kut Company
Rockbar Corp.
River Edge Industries
Sonotone Corp.
Stephens Manufacturing Corp.
Technical Tape Corporation
Telectrosonic Corporation
The Pentron Corp.
United Transformer Co.
University Loudspeakers

ASSOCIATE MEMBERS
Audio Magazine
High-Fidelity Magazine
Sleeper Publications Inc.


George Silber, Pres., Institute of High Fidelity Manufacturers, Inc.

One of the first undertakings of the Institute will be the holding of a public high fidelity show at the Benjamin Franklin Hotel in Philadelphia on November 4th, 5th, and 6th. This is to be the forerunner of other shows to be sponsored by the Institute throughout the country in 1956.

The whole idea behind these shows is to give the American people a fair presentation of high fidelity, in terms of equipment that is truly capable of high fidelity—and in the idiom of the experience as it applies to the home. By thus exposing the public to high fidelity—at its best—it will develop the ability to distinguish between fact and fiction. And the understanding which is now lacking, will be promoted—if not ultimately, established.

In later columns we shall discuss other plans which have been proposed to deal with this question. All of this is within the scope of purposes for which the 'Institute' was constituted. And these purposes can be summarized in one sentence: To insure that the buying public, when specifying "high fidelity" will understand the order of quality that it designates and implies, and will thereby be better able to obtain and enjoy the benefits of present and future advances in the art.

We invite the comments and suggestions of the readers of this magazine to help us evolve a program for the good of the greatest number. Please address all correspondence to: Audio Magazine, P. O. Box 629, Mineola, N. Y.

acceptance. The phrase "high fidelity" has lost whatever reliable meaning
its best—it will develop the ability to distinguish between fact and fiction. And

SOUND

EDGAR M. VILLCHUR*

Chapter I. The author begins a discussion of audio subjects with a simple description of the nature of sound—musical or otherwise.

It is common knowledge that the generation of sound is associated with mechanical vibration, although the exact nature of this vibration, and the way in which it communicates itself to our ears, is not as widely understood. Newton referred to sources of sound as "tremulous bodies". This is an apt expression, because it implies a to-and-fro motion which is small, fast, and constantly repeated.

The vibrations of stretched strings, reeds, or membranes are familiar examples of such motion. When the vibrating body advances it pushes against the air with which it is in contact, compressing the molecules in front of it. Force applied to a rigid body would cause the whole body to move like a piston, all parts in unison, but an essential characteristic of an acoustic medium is that it is elastic. The molecules of air, therefore, are instead propelled against the neighboring particles, which in turn transmit the pressure to *their* neighbors, and a pressure impulse moves out with a definite speed from the original disturbance. When the source retreats it draws the nearby air towards it; the resulting partial vacuum is filled in by particles further out, and this time a rarefaction impulse travels out from the source.

Thus we have an impulse, alternately of compression and of rarefaction, which moves out from the oscillating source and which controls the behavior of the particles in its path, causing them first to crowd together and then to spread apart. A given particle imitates the to-and-fro motion of the source, but with a time lag, like that between the leader and followers of a "Simple Simon says" game. The time lag grows progressively greater with distance, and since the pressure changes are spread over an increasingly larger area, as the sound impulse moves out the imitative vibrations of the air molecules become weaker.

* *Acoustic Research Inc., 23 Mount Auburn St., Cambridge 38, Mass.*

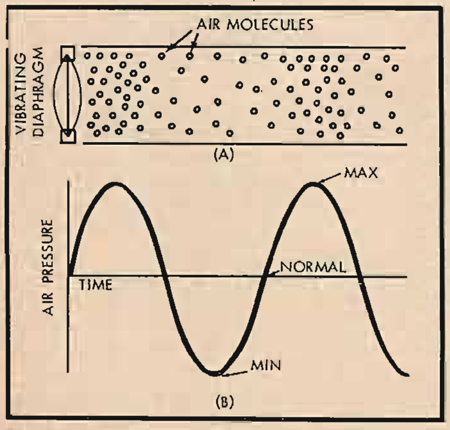

Fig. 1-1 (A) Alternate compression and rarefaction of air caused by sound. (B) The physical picture of (A) represented symbolically by a graph.

The vibrations of a source of sound are small: they may cover as much as a sizable fraction of an inch. But the human ear can detect particle "excursions" of microscopic distances—as little as .0001 inches—and it can detect changes of pressure of the order of magnitude that would be created by raising or lowering a body in the earth's atmosphere about one foot.

Sound travels as a "wave," and hence the transmission is accomplished without permanent displacement of air. This transmission can only take place through an elastic medium, a fact which was finally demonstrated by the classical experiment in which a bell and clapper were placed in an evacuated glass jar. The bell's vibrations were made inaudible, as sound could not be transmitted through the vacuum. (The apparatus had to be constructed many times by different experimenters before sufficiently refined techniques were developed to completely isolate the vibrations of the bell from the world outside the jar.) If the moon is ever visited one feature of the environment will be known beforehand with certainty; the wastes will be noiseless except for vibrations transmitted through the solid surface. Since there is no gaseous atmosphere there can be no tread of footsteps heard, no rustle of clothing, and if an obstruction is dynamited the débris will fly apart silently, as in a dream.

When a stone is dropped into a pool of water, waves travel out in all directions. This phenomenon is often used as an analogy to the action of sound waves. The force of the dropped stone is sent out through the water, but the particles of water merely vibrate in orderly sequence and do not travel with the force. There is an important difference, however, between this type of wave motion and that of sound. The particles of water vibrate up and down, in a direction transverse to the direction of wave travel, rather than back and forth along the path of the wave (as they would if they were transmitting sound). The water wave is thus called *transverse*, the sound wave *longitudinal*.

It is easy to draw a picture of a transverse wave which will reveal its characteristics; we merely take a cross-sectional side view of the medium at any particular moment. It is more complicated, however, to make a pictorial representation of a longitudinal sound wave. We would have to show the particles alternately compressed and rarefied, as in (A) of *Fig.* 1–1, and since we could only show a few particles the picture would be a crude one. Therefore we abandon pictorial representation and substitute a symbolic graph, as in (B) of *Fig.* 1–1. Where the graph line crosses the horizontal axis the medium is in its normal, undisturbed state; where the graph reaches its peak height the medium is compressed to a maximum degree; and where the graph reaches the bottom of its "trough' the medium is at maximum rarefaction.

This graph represents the pressure state of the medium at a given point, as it varies over a period of time. We must always remember that these graph "wave forms" are not pictorial, and that, unlike ocean waves, sound waves do not physically look like their graph curves. The ocean wave actually forms such a pattern in space because of the fact that its particles vibrate transversely.

The Characteristics of a Sound Wave

The adoption of the above method for graphically representing sound waves makes an analysis of the quality of a sound much easier. A person would never mistake a buzz-saw for an oboe, but the differences can also be detected by an oscilloscope and stated in purely quantitative terms. The graph of pressure *vs.* time will tell the story if we know how to read it.

First, consider the height of the graph, from peak to trough. The greater the vertical distance the more the air is being compressed and rarefied, the greater the excursion forced on the ear drum, and the greater will be the intensity of the sound. This characteristic is called *amplitude*.

The second significant characteristic of the graph is the number of times per second the complete sequence of vibratory events, called *cycles*, occurs. This characteristic is referred to as the *frequency*, and the sensation of pitch depends on it. The higher the frequency the higher the pitch. But all sounds do not have pitch, as is evident from listening to many of the everyday sounds of the street. The existence of a definite pitch requires that a number of successive cycles of the same frequency be

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eous atmosphere there can be no tread
of footsteps heard, no rustle of clothing,
quantitative terms. The graph of pressure vs. time will tell the story if we know how to read it.

repeated. Regularity of this nature makes the sound a *periodic* one. Nonperiodic sounds are produced by automobiles, by leaves in the wind, or by the jangle of keys on a ring, and are referred to as noises rather than musical tones. Periodic sounds are produced by musical instruments—middle *C* on the piano, for example, represents a string vibration whose frequency is approximately 261 cycles per second (abbreviated as 261 cps). The frequency range of audible sound for a normal young person is about 20 cps to 20,000 cps.

The third feature which must be taken into account is the shape of the graph, or the *wave form*, which determines timbre. The graph of *Fig.* 1–1 is that of a sound created by the simplest of vibrations. It is called a sine wave. It is found relatively rarely in nature and has a tone which has little interest musically. The tone produced by blowing across the top of a bottle is of this type, except for its noise component. The characteristic timbre of various musical sounds is associated with a characteristic wave form, and it is this element which will immediately allow us to differentiate the oscilloscope pattern of one sound from another.

The reproduction of the tones of a whole symphony orchestra by a single vibrating speaker cone becomes less of a miracle when we understand the full significance of the wave form of sound. The wave form graph, besides representing the instantaneous pressure state of the air, may also be thought of as representing the instantaneous position of the human ear drum receiving the sound. It is obvious that, no matter how many sounds from how many instruments are being heard at the same time, the ear drum can be in only one position at any particular instant. Since we are able to hear and distinguish many sounds at once, evidently the single, complex vibration, and a single complex wave form can represent a combination of many different sounds. An oscilloscope picture of the wave form of the total sound of a symphony orchestra would be formed by a complicated but single line, and a headset diaphragm could theoretically reproduce exactly the same ear drum vibration as 75 musical instruments playing together.

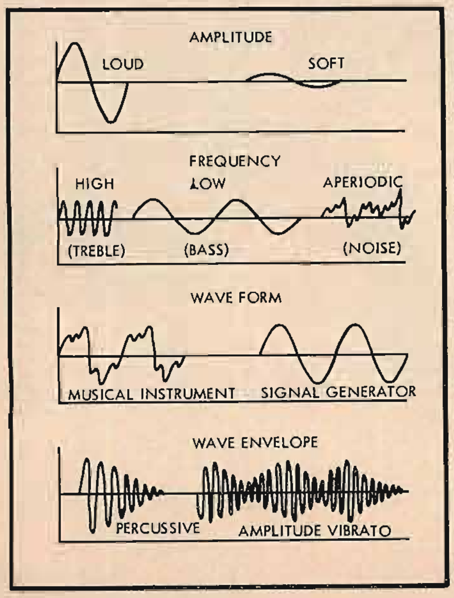

Fig. 1-2 The four physical characteristics of sound.

A fourth characteristic of sound is more subtle but not of less importance. It has to do with the instantaneous changes of volume which take place, especially those involved in the starting and stopping of the sound. The wave characteristic which defines this element is called the wave envelope, and it describes the transient attack and decay of a tone, one type of vibrato, and crescendo and diminuendo.

The physical characteristics of sound listed above—the amplitude of the pressure changes, the frequency, the wave form, and the wave envelope—are associated with the sensations of loudness, pitch, timbre, and the sensation inspired by instantaneous amplitude changes, in that order. This is illustrated in *Fig.* 1–2.

Although these associations are primarily correct the sensations are not each determined exclusively by one physical characteristic. Loudness is also affected by pitch, pitch by loudness, timbre by wave envelope, and so on.

Musical Instruments

The sound quality of a musical instrument, which we describe with subjective terms such as "fiery," "melan-

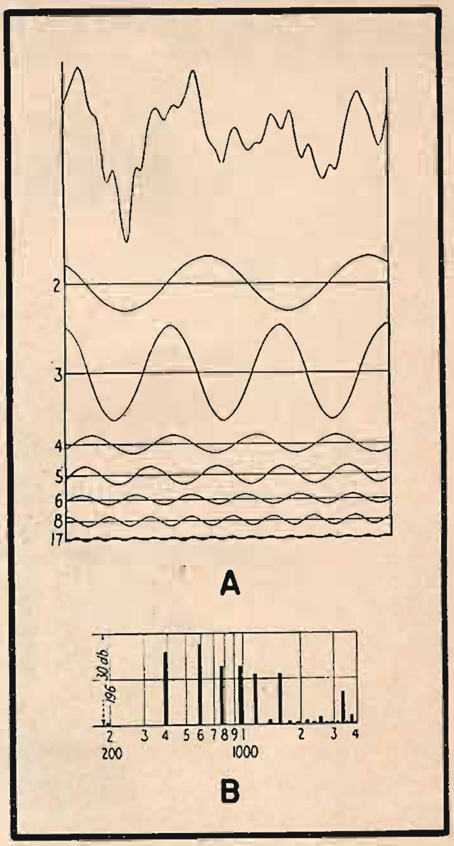

Fig. 1-3 Wave form and harmonic composition of a violin tone (G below middle C). (After Seashore)

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choly," "brilliant," etc., can also be described in terms of the four physical characteristics of sound referred to above.

The most dramatic characteristic of an instrument is its *timbre,* which we have seen is primarily associated with wave form. Musical instruments vibrate in complex ways; in addition to vibrating at the frequency corresponding to the musical note on the score, they also vibrate simultaneously at many other, higher frequencies. The basic tone which identifies the pitch is called the *fundamental,* while the higher frequency components are called *overtones.* It is the particular combination of fundamental and overtones, in number, kind, and relative amplitude, that determines the wave form and the timbre.

In most musical instruments the overtone frequencies are simple multiples of the fundamental frequency. Such overtones are called *harmonics.* Thus if the fundamental tone is *A* above middle *C*, 440 cps, the second harmonic will be 880 cps, the third harmonic 1320 cps, and so forth. The general musical term for any component of a sound, whether fundamental or not, is *partial.*

The wave form and make-up of the complex musical tone of a violin, showing both the fundamental and harmonic overtones, is illustrated in *Fig.* 1–3.

Not all musical instruments, however, have overtones that are harmonic. Certain instruments of the orchestra, as a matter of fact, simultaneously produce such a varied assortment of harmonically unrelated frequencies that there is no definite sensation of one pitch. Strike tones and inharmonic overtones make up a large part of the sound of such members of the percussive group as the triangle, the bass drum and cymbals.

It is also true that certain musical tones, with harmonic overtones, have weak and even inaudible fundamentals. The lowest strings of the piano are examples. We nevertheless clearly identify the pitch correctly, because we recognize the harmonic structure and we respond to the *difference frequency* between harmonics (which, of course, is always the fundamental frequency). This phenomenon of hearing accounts for the fact that tones from the double bass or organ pedal pipes, when reproduced by table-model radios which are incapable of vibrating at the low fundamental frequencies involved, can still be recognized musically.

Musical instruments also differ widely in relation to the three characteristics of sound other than timbre. The majesty of the full pipe organ is partly due to its ability to pump very large quantities of vibrating air from its pipes, and to achieve tremendous volumes of sound. Some instruments, such as the pipe organ and piano, cover the entire musical range of fundamental frequencies, while others are specifically designed for bass or treble passages. The attack and decay of musical instruments may be characterized by sharp attack and slow decay, giving the sound a percussive quality, or by a gradual rise and fall of volume.

Units of Measurement

There are two units of measurement in sound that should not be omitted from this discusion. One is the musical pitch interval—the octave, whole tone, etc.—and the other is the engineering unit used to measure sound power, the decibel. Both are basically the same in concept.

A piano keyboard seems to be divided up evenly as far as pitch is concerned. The same apparent rise in pitch is produced by going from middle *C* to the next higher *C*, then to the *C* following, and so on, or from *C* to *D* to *E*. The first mentioned musical interval is called an *octave,* the second a *whole tone.* From *C* to *C* sharp is a *half tone.*

This apparently even division does not correspond to a similarly uniform physical division of frequency. As we increase the musical pitch, octave by octave, we are not adding equal increments of cycles, but are instead multiplying the frequency by two. Starting at 440 cps, one octave up will take us to 880 cps; two octaves up will take us not to 1320 cps but 1760 cps. A musical interval thus represents a geometric *ratio* of frequency, not a given number of cycles. An octave at the bottom of the keyboard covers only 27.5 cps, while an octave at the upper end covers 2093 cps. The range of musical pitch, however, is the same for the two, because this is the way we perceive sound.

The decibel is a similar unit of ratio, except that it refers to sound power, and the basic multiplier in the db system is 10 rather than 2.

We could construct in our mind's eye a special keyboard instrument in which all keys played the same frequency, and where ascending the "scale" increased only the volume of the sound. This hypothetical instrument could be calibrated in decibels by designing it so that every ten keys increased the sound power ten times. For example, if .01 watt were produced by a given key, ten keys further up would produce .1 watt, and ten keys further, 1 watt. Each such group of ten keys would correspond to a power ratio of one *bel,* while each adjacent key would increase or decrease the power by one *decibel.*

The decibel, or db, represents, under certain conditions, the minimum difference in sound power that the average human ear can perceive. There are conditions (such as at the lower frequencies) when several decibels of change are required for a person to notice the change of volume, and there are also conditions in which a small fraction of a decibel can be perceived.

The main reason for the adoption of the decibel system is the same as the reason for the octave system in music: that's the way we hear, in terms of geometric ratio rather than arithmetic increments. Thus if we want to plot the performance of an audio component over the frequency spectrum, and require a graph which lays out the ranges of fre-

always the fundamental frequency). This phenomenon of hearing accounts
and ten keys further, 1 watt. Each such group of ten keys would correspond to

quency with the proper importance assigned to each range, we imitate the piano keyboard and use a geometric scale. When we describe the output of this component at different frequencies we state variations in relative db units, rather than in absolute units such as watts. The former is more accurate in terms of perception, and hence more meaningful.

The similarity between the layout of a piano keyboard and of frequency response graph paper used in audio work is illustrated in *Fig.* 1–4. A comparison between a linear (arithmetic) and decibel (geometric) scale of power is illustrated in *Fig.* 1–5.

We have discussed the decibel as a unit of relative sound power; it is also used as a unit of relative electrical power, or it can be applied to such quantities as voltage, current, sound pressure, and sound intensity (power per unit area). When a level of sound is described in db a reference level is always given or assumed.

Let us make a simple application of the decibel system in order to see how it affects the significance of absolute values. Suppose we own a ten-watt amplifier, and are not satisfied with the power capability of our system for the room in which it is used. We substitute a twenty-watt amplifier. How much have we increased the volume of sound that we can call on? A power ratio of two to one is represented by 3 db, not a very damatic increase. Forty watts will give us a 6 db increase over the original ten watts.

Resonance

Resonance is the basis of musical instrument design; it also plays an important but usually unwelcome role in sound reproducing systems.

If we pluck a stretched piano string it will vibrate for a while at a certain frequency. It we try it again we will find that the fundamental frequency is the same. This frequency is its natural or *resonant* frequency.

When the string is first released it is in a position of stretch, and it springs back. But when it has straightened itself out it is moving transversely at high speed, and momentum carries it beyond its neutral position, into a position of stretch on the other side. The overshoot is stopped by an opposing elastic restoring force, and the same half-cycle of events begins again, this time in the opposite direction.

It may be seen that the original energy injected into the system is not absorbed by either the elastic or the mass element, but is stored temporarily by each in turn, and is poured back and forth from one to the other like a Bromo-Seltzer being prepared at a drug counter. The rate of interchange of this energy, which is to say the resonant frequency of the system, is determined by the relative values of mass and elasticity of the string. This is why the strings of the piano become progessively heavier as the pitch decreases, and why tightening the strings of a violin, which increases their elastic restoring force, raises the frequency of the tone produced.

The vibrations cannot go on indefinitely, because energy is lost with each excursion—partly through mechanical and acoustical friction, and partly through the energy represented by the radiated sound. If no new stimulus is given to the string, each overshoot becomes less than the previous one, until the system has come to rest. The process of energy absorption which brings motion to a halt is called *damping*. Heavy damping stifles the sound quickly, while a relatively undamped system allows the tone to continue for a long period of time.

The restoring force of a freely vibrating mechanical system may be supplied by gravity as well as by elasticity, as it is in the case of a suspended pendulum or of water sloshing about in a washbowl.

Forced vibrations are of a different character. The stimulating energy cannot be a one-shot affair but must be applied continuously, and the vibrating element follows the dictates of the stimulus rather than of its own resonant tendencies. But all mechanical systems have mass and restoring force to some extent; there is no such thing as a massless body or perfect rigidity. The loudspeaker, too, has its own resonant characteristics which we cannot exorcise even though we might like to. A system subjected to forced oscillation acts differently when the frequency of the stimulus comes close to or coincides with the natural frequency of the system itself. It offers much less resistance (technically the term is impedance) to being vibrated, and as a consequence the oscillatory excursions are very much greater than they are at other frequencies, even though the magnitude of the stimulating force has not changed.

Thus when a recorded bass viol sounds a tone which happens to be at the resonant frequency of the phonograph's loudspeaker there is a tendency for that particular tone to "boom." Fortunately there are ways to mitigate and even to completely overcome this tendency.

A dramatic example of the results of resonant behavior is given in the description, according to one theory of geophysics, of the formation of the moon. The entire surface of the originally molten earth, it is stated, followed a tidal ebb and flow created by the gravitational influence of the sun, which alternately, according to the rotational position of the planet, caused the surface to lead and lag its spinning core. (The day was then about four hours instead of twenty-four). We can readily recognize the situation as one of forced oscillation of an inertia-gravity system, whose frequency was controlled by the velocity of rotation of the earth about the sun. This veloctiy began to decrease, due to frictional losses incurred with each tidal shift of the surface. It is reasoned that at some point the frequency of tidal oscillation coincided

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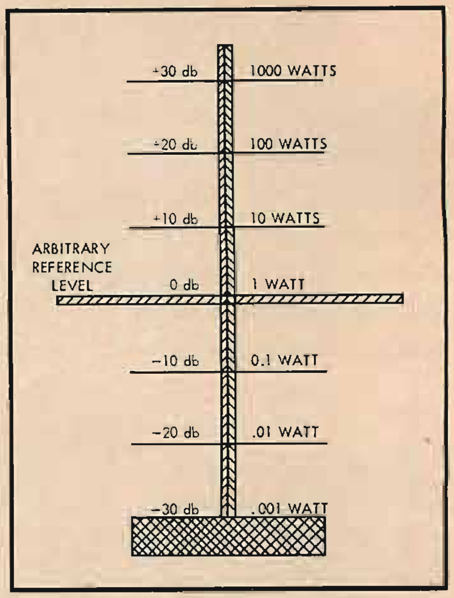


Fig. 1-5 Comparison between a linear (arithmetic) and decibel (geometric) power scale.

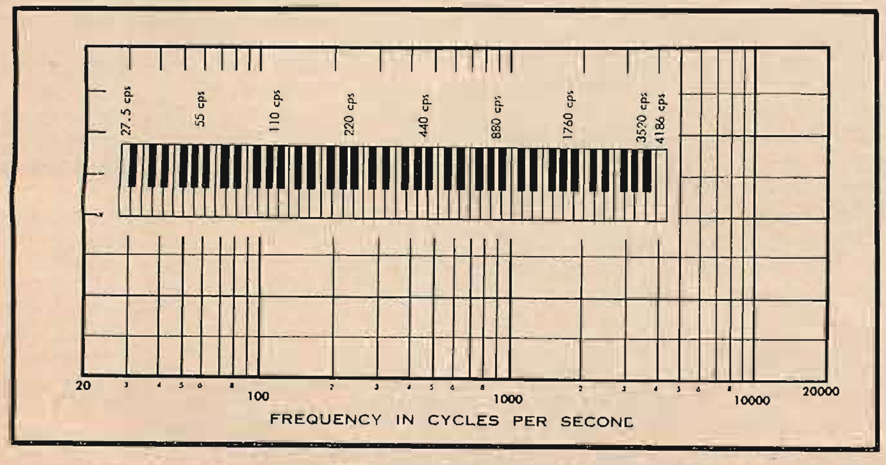
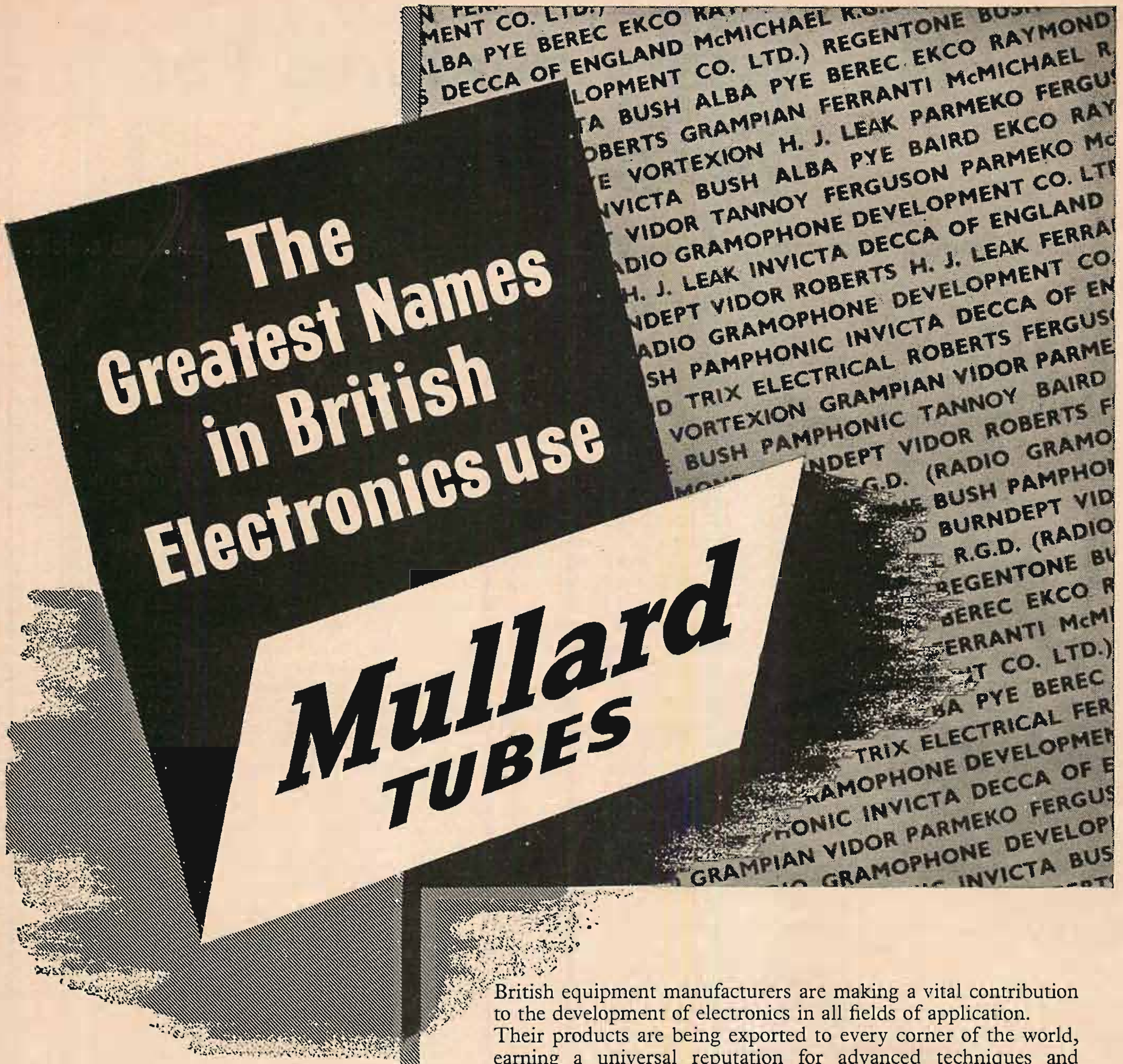


Fig. 1-4 Comparison between the frequency scale of a piano keyboard and that of an audio frequency response graph.

ency.
A dramatic example of the results of



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Necessary Features For Design Patents

Court decisions indicate some of the essential ingredients of a proper design-patented article.

ALBERT WOODRUFF GRAY*

AN APPLICATION FOR A DESIGN PATENT of a vacuum capacitor was recently before the Federal Appellate Court. The description by the court was, "A glass envelope of a distinctive pattern within which was displayed the condenser body of general cylindrical shape supported in coaxial relation to the body. Thin rod-like conductors extended through inwardly disposed projections within the ends of the envelope from outwardly curved ends of the condenser body to stepped terminals extending axially outwardly from the ends of the envelope."

The Patent Office rejected the application, holding that the invention lacked novelty in the light of previously granted patents, two for electron discharge devices, two for similar patents, and one for a short-wave tube.

"The design," said the Patent Office Board of Appeals in sustaining the rejection, "shows a cylindrical condenser body enclosed in a bulbous glass envelope with external connector caps. The shape of the envelope suggests that it is made in two similar halves united by a fused peripheral seal around the inserted condenser. The evacuation of the sealed envelope to protect the enclosed elements and the mode of sealing speculated upon above, are obviously utilitarian features not involved in the design under consideration."

The inventor appealed from these adverse decisions and in its reversal of the rejection the Federal court said, "We feel constrained to disagree with the concurring conclusions reached by the tribunals of the Patent Office. In considering patentability of a proposed design the appearance of the design must be viewed as a whole."

The patent law enacted in 1952 in relation to design patents is in part, "Whoever invents any new, original and *ornamental design* for an article of manufacture may obtain a patent therefor."

The original design-patent law passed in the early years of the last century provided for a patent only for "any new and original design." It was not until the amendment of the law in 1902 that this present phrase, "new, original and ornamental design" was included in the statute. In that sentence however are set out the three essentials for a design patent—new, original, and ornamental.

An application for a patent of this character on a radio loudspeaker claimed, "An ornamental design for a loudspeaker," with the drawing disclosing a loudspeaker with a circular outline. A design patent had previously been issued for a loudspeaker with an octagonal outline. From the rejection of this application by the Board of Appeals of the Patent Office the inventor appealed. The appellate court in its affirmance of the rejection based its conclusion on the absence of one of these essential features—originality.

"In order to sustain the application we must find that the change of design from an octagonal sound board to a circular sound board is inventive in character. This we cannot do. The mere choice of a well known geometric form rather than another equally well known, which does not in any way modify the other portions of the design cannot support a patent."

Another decision of the Federal court at that time sustained the rejection of a similar application for its lack of both artistic conception and invention. That application was for a radio reproducer resembling a common mantle clock with an elongated base and a curved top. Two design patents however had already been granted on similar designs thus depriving the applicant of a claim for either ornament or invention.

"Applicant's radio reproducer," said the court, "was made to imitate and resemble a common mantle clock. In general configuration, except as to the degree or slant of the curves or angles, there is very little difference between this design and the previous design of a sectional clock case.

"In the front of the case is a circular opening of substantially the same size as the previously patented design. In applicant's design the opening is covered by a grill instead of a clock face through which sounds from the radio are transmitted. In the other previous design of a prism plate we find substantially the same configuration as in the grill work of applicant's design.

"In other words, if the previously patented clock case was fitted with a prism plate and used for a radio reproducer, substantially the same result in purpose and ornament would be accomplished. Applicant has combined two old features without new ornamentation. There is no such new inventive beauty of artistic conception as to be patentable."

In another appeal involving a cone-shaped loudspeaker before that court the following year, it was held that no invention was shown over an octagonal one. "The right to make any article, round or square or in any other standard form or shape," said the court, "is inherently open to all and novelty cannot be predicated on a design for a square candle instead of the ordinary round one."

The essential of invention, the novelty required by the statute for a design patent was emphasized in the decision by a Federal court in Michigan, in which that court said, "Design patents stand on as high a plane as utility patents and require the exercise of as high a degree of the inventive faculty." Here an application had been made for the patent of a combined testing and charging stand for electric batteries. It had been customary before that time in battery shops to use a rack or bench for batteries. The subject of this patent application was the design of a cabinet with a door concealing the batteries and protecting customers from any possible contact with electrical connections and on the face of this box or cabinet was installed an arrangement of indicating dials.

The court in refusing this patent application followed as an authority an earlier decision which had sustained the rejection of a design patent application for an automobile lifting jack.

"There is no invention," said that court, "in merely selecting and assembling the most desirable parts of different mechanisms where each operates in the same way in a new device as it did in the old and effects the same results.

"It requires only the commonest kind of skill, such as any mechanic ordinarily skilled in the art could and would have exercised, to borrow from well known styles of jacks one or more of their operative parts and put the same into another, there to perform the same function as such respective part performed in the first.

"This lifting jack patent, for want of patentable invention and novelty, cannot be sustained. The production of such a design did not call for the exercise of the creative faculty. Originality is wanting. The beauty of the design is not impressive. For these reasons the patent must be held invalid."

In the conclusion of its decision in the case involving this battery testing cabinet, the court added, "The patent design lacks both ornamentation and

(*Continued on page 52*)

*3712 75th St., Jackson Heights, N. Y.

feel constrained to disagree with the concurring conclusions reached by the tribunals of the Patent Office. In con-
there is very little difference between this design and the previous design of
same way in a new device as it did in the old and effects the same results.
"It requires only the commonest kind

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MODEL 11
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MODEL 800 •
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MODEL KR-3
MODEL KR-3U
MODEL KR-4-12
MODEL KR-4-15
MODEL KR-5
MODEL KR-5-U
MODEL KR-5-P
MODEL ST-1 •
MODEL ST-2 •
MODEL ST-3 •
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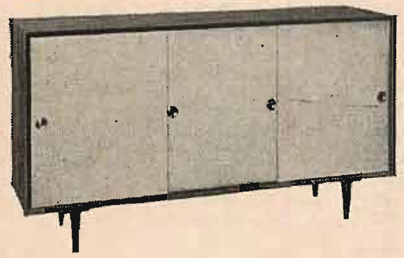
MODEL ST-8 •
MODEL ST-9 •

MODEL 65



. . . storage for tape recorder, turntable, record changer, tuner, amplifier and speaker, if desired.

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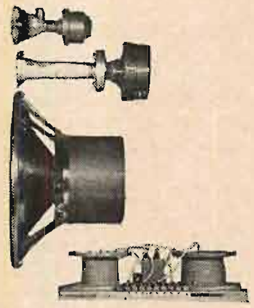

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KIT KST-2 •
KIT KST-3 •
KIT KST-4 •
KIT KST-5 •
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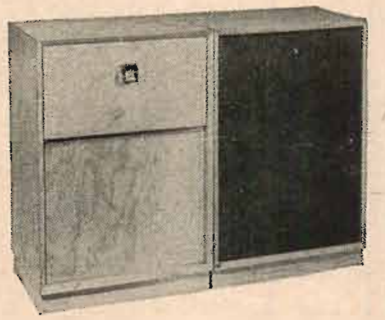
KIT KST-7 •
KIT KST-8 •
KIT KST-9 •

MODEL 27K
MODEL 28K



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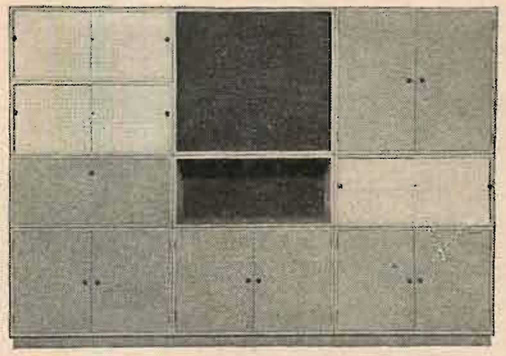

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New Equipment

Triad Amplifier Kits HF-3, HF-12, HF-18, HF-40—Recheck on Crestwood 304 Tape Recorder

Because of the fact that this particular line of amplifiers has not been built and then tested as is the normal procedure for Equipment Reports, this section is titled "New Equipment" and serves in a similar manner to describe these four amplifiers that are intended for the home constructor, and which are so well engineered as to warrant an especial mention.

Kit amplifiers—as well as test equipment—are popular with the home constructor because they provide all the necessary parts for the finished product in a form that is sufficiently complete that the builder does not have to shop around for the last screw or for an escutcheon plate that will provide him with a commercial-looking finished product. And because they are intended for construction by the inexperienced builder, they are usually engineered to a high degree of perfection so that it is easily possible for even the complete novice to end up with a piece of equipment that will work right from the start with performance as good as would be expected from a factory-built unit. Manufacturers of radio and television sets have been known to depend on minor amounts of regeneration to obtain the desired performance, and in those instances the placement of leads is likely to play an important part in the final performance. With a kit amplifier or test instrument, the manufacturer must "iron out all the bugs" before he puts the device on the market to avoid considerable dissatisfaction from his customers and a large amount of letter writing whch is unsatisfactory to both customer and manufacturer—as well as being expensive for the latter. Thus any kit that reaches the market must give a high degree of satisfaction to the user, must be thoroughly documented as to the exact steps taken in construction, and must be so thoroughly stable that no trouble shooting will be necessary—a procedure that could never be followed by an inexperienced builder. Every kit that we have been privileged to examine over the past year or so has come up to these requirements satisfactorily.

Fig. 1. Triad HF-3 Preamplifier and control unit.

The Triad line of amplifiers consists of a self-powered preamp-tone control unit, a 12-watt model with built-in preamp and tone-control section, an 18-watt amplifier of the Williamson type, and a 40-watt amplifier employing a pair of 6146's. The last two models require separate control sections.

The preamp-tone control unit, HF-3, consists of a 12AY7 preamplifier stage, followed by a 12AU7 which provides additional gain for the tone-control functioning. The preamplifier is designed to accommodate both magnetic and crystal or ceramic pickups, the latter being reduced to a constant velocity characteristic by the use of a low value of input resistor. Nine characteristic curves are provided, which cover practically any recording characteristic that might be encountered. Bass and treble tone controls operate to bypass a cathode resistor for the boost positions and to shunt either highs or lows—or both—to ground for the cut positions. The power supply provides 280 and 275 volts, well filtered, for the plates, using two chokes and 90 µf of capacitance in the filtering. It also furnishes 12 volts d.c. for the heaters, thus ensuring a very low hum level for the unit. The schematic of the HF-3 is shown in *Fig. 2*, while the external appearance of the chassis is shown in *Fig. 1*.

The 12-watt model, HF-12, consists of this same "front end" (except for the

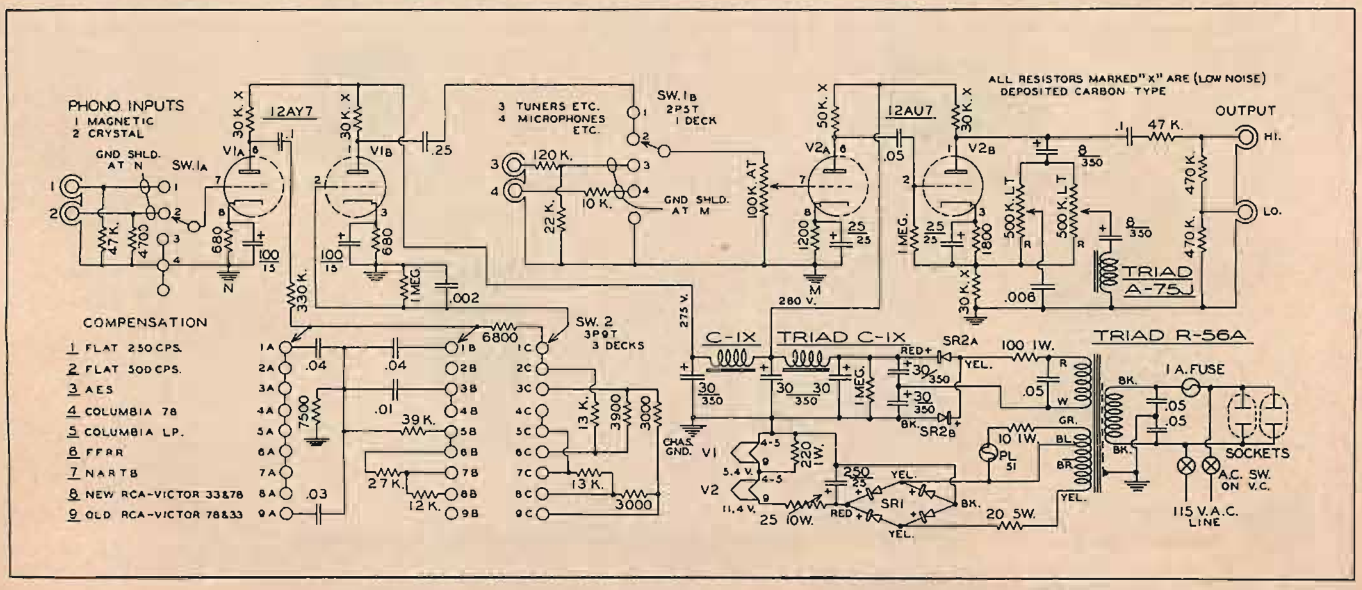
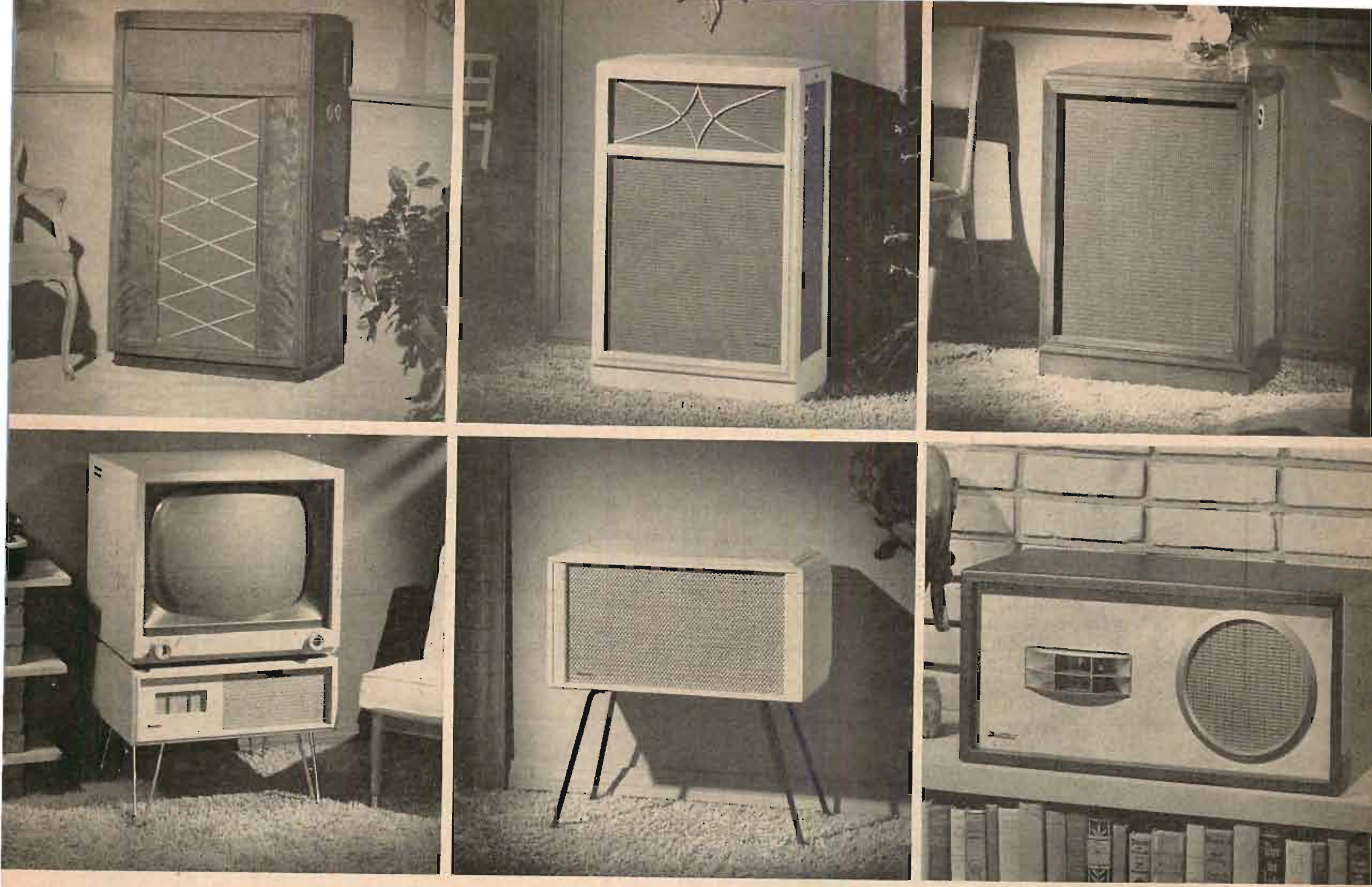


Fig. 2. Schematic of the Triad HF-3 preamplifier and control unit.



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And you'll feel this excitement again and again . . . with every added hour of musical revelation, with each new disc or tape you try.

You probably won't try to analyze the exhilaration, the sense of complete satisfaction that grows with time; you don't really need to, for the sound speaks for itself.

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(top left) PR-100 Imperial, 3-way system $525.00 in Mahogany; $535.00 in Blonde. (top center) TP-200 Tri-plex, 3-way system $312.70 in Mahogany; $316.80 in Blonde. (top right) CT-100 Concerto, 2-way system $164.50 in Mahogany; $168.00 in Blonde. (lower left) DU-500 TV-Duette, 2-way system $85.50 Blonde Oak, brass hairpin legs. $82.50 in Mahogany, wood legs. (not illustrated) DU-400 TV-Duette $49.50 Blonde or Mahogany finish, wood legs. (lower center) DU-300 Duette "Treasure Chest" 2-way system $76.50; wrought iron legs $4.25. (lower right) DU-201 "Duette" Reproducer, 2-way system $62.50 in Burgundy pigskin-grained Fabrikoid.

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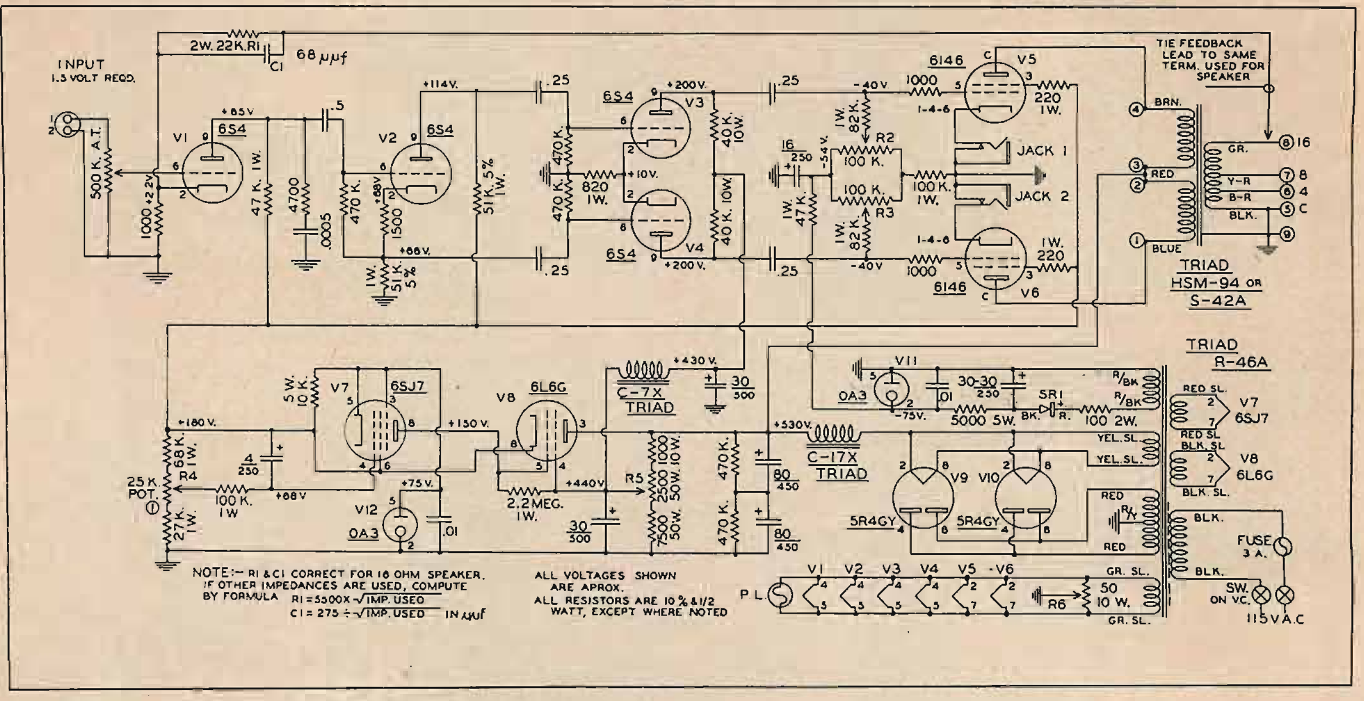

Fig. 3 (above) Schematic of the HF-40 amplifier, and Fig. 4 (left) its external appearance.

d.c. heater supply) followed by a three-stage power amplifier ending with 6V6's—the power section consisting of a 6SJ7 direct coupled to the first grid of a 6SN7 and the first plate of this tube is direct-connected to the second grid to form the phase splitter. The output from the phase splitter is taken off the cathodes of the 6SN7. Feedback is returned to the cathode circuit of the 6SJ7, and output impedances of 4, 8, and 16 ohms are available.

The 8-watt model, HF-18, is a conventional Williamson amplifier which may be used as an Ultra-Linear with a few simple changes in wiring—both hookups being shown in the instructions. The power supply filtering is thorough, and furnishes 480 volts for the KT-66 output stage through one choke, 455 volts to the driver through two chokes, and lower voltages through RC filters to the first stage and phase splitter.

The 40-watt model, HF-40, is shown in *Fig.* 4, and pictured schematically in *Fig.* 3. It consists of a 6S4 input stage driving a 6S4 split-load phase splitter, followed by a pair of 6S4's as a driver stage and the 6146 output stage. The 6146's work with a plate supply of 530 volts and a fixed bias of 40 volts, with the tubes being separately adjustable from about 35 to 54 volts. A voltage divider supplies 440 volts for the driver stage, and a regulated power supply provides a fixed voltage of 180 for the 6146 screens and for the input stage and phase splitter. Feedback extends from the secondary of the output transformer to the cathode of the input stage.

In addition to the normal schematic of the amplifiers, complete pictorial drawings of the finished units are furnished, together with detail drawings of the subassemblies such as phono equlization switches, mounting of parts, and so on. The instructions for step-by-step construction are clear and concise, and are sufficiently complete for even the most inexperienced constructor.

On listening tests all four models perform satisfactorily with no "bugs" or idiosyncracies that could be detected. Phono equalization seems to be adequate in the two models with preamplifiers, and the tone control action is smooth and offers a low-frequency boost curve that is preferred by some listeners.

The manufacturers are to be complimented for the clarity and simplicity of the constructional information, and for the workmanlike design and layout. Decals are furnished for the chassis, and while the control unit, HF-3, might require some thought on the part of the constructor to fit it into a cabinet conveniently, its performance is sure to be considered satisfactory.

This description of the kits was not included in the section on AMPLIFIERS AND PREAMPLIFIERS in the January, 1955, issue because it was felt that they deserved a more complete presentation. S-15

RECHECK ON CRESTWOOD 304 TAPE RECORDER PERFORMANCE

The performance curves for the Crestwood Model 304 Tape Recorder which appeared in the June issue left something to be desired with respect to the quality of recording from radio or microphone input and playback from the tape so recorded, although the performance from the Ampex standard tape was considered quite satisfactory. Crestwood engineers differed with us in their measurements of this unit, and suggested that it was possible that an error had been made or that possibly the changeover switch was not making proper contact. Our own measurements did not seem to come up to what would be considered normal, and further checks were made on another unit of the same model. These measurements indicated that the response from radio and microphone inputs followed those from the standard tape and that the curves of the "in and out" measurement should fall within the same limits shown in the portion of the curves labeled "Tone Control Range."

We are pleased to be able to report that this instrument does work better than it appeared to under the first observation, since the Crestwood 400 series of recorders gave such a fine performance and it was to be expected that the 300 series would fall in the same category. S-16

direct coupled to the first grid of a 6SN7
and the first plate of this tube is direct-
age divider supplies 440 volts for the driver
stage, and a regulated power supply pro-
standard tape was considered quite satis-
factory. Crestwood engineers differed with

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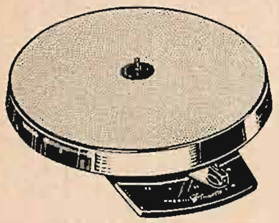

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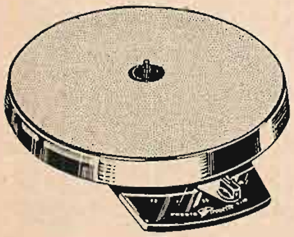

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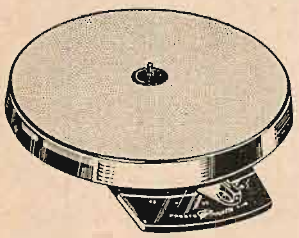

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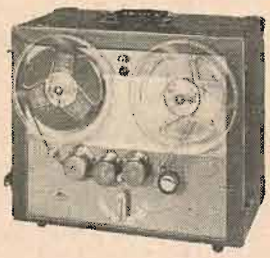

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EDWARD TATNALL CANBY*

1. Pipe Organ

My first conclusion, as I look at and listen to the following batch of pipe organ records, is that there is still a confusion of aims and interests. For whom are these records intended—for what variety of interest? The music? The organ itself? The performer and his technique? The low bass, for hi-fi systems? And if the music—which kind of music? We have everything here from theatre-organ pops to Reger, Widor, and Vierne, not to mention a gent who appeals to a different school of listener, Mr. J. S. Bach. I find that the thinking which assembles these records is still on the fuzzy side, or perhaps more likely, represents too many recording cooks' ideas in the broth.

I still feel that the first volume of the Aeolian-Skinner "King of Instruments" series, with the detailed analysis of organ tone and tonal usage by G. Donald Harrison was one of the best *records* on the organ so far put out; it was to the point, unequivocal, well marshalled in its musical material for direct and specific ends. Similarly, the splendid Biggs album "Art of the Organ" from Columbia, featuring numerous European organs, very old and very new, in a beautifully balanced program of Pachelbel, Buxtehude and Sweelinck, (giants of the late 17th and early 18th century) was another well-thought-out job: the organs first, the music second but in perfect harmony, a single and sympathetic performer and, as a useful incidental, some very fine hi-fi sound. See below for its successor.

And in case you think I'm an organ snob, the "Mighty Wurlitzer" recording reviewed below is just as good in its own entirely consistent way. No question about its interest and intent and it's a whiz of a record in its own area. The others aren't so easy to pin down.

Bach: Toccata in D Minor (A Hi-Fi Adventure). E. Power Biggs. Various organs. Columbia ML 5032

This successor to Mr. Biggs's SL 219, that featured three composers on numerous European organs of the classic period, is a stunt and a good one, quail though you may at the prospect of a single piece repeated 14 times, ad semi-nauseam!

Mr. Biggs toured numerous countries on his organ-hunting expedition and upon each organ he played, in addition to the aforementioned series of works by the three big "pre-Bach" organ composers, a performance of the famous Toccata, by Bach, the one that Stokowski arranged for orchestra and that Disney put into his "Fantasia." (Mercifully, Biggs omits the long fugue that goes with it, except for one playing at the end of the record; the Toccata is relatively short and easy to repeat, but 14 versions of the fugue would be a lot too much.)

The Toccata repetitions are surprisingly easy to take, nor do you really have to play all 14 versions one after the other unless you are chained hand and foot to a changer mechanism. The reasons aren't hard to find. Here we have a set of arbitrarily fixed conditions—same player, same piece of music—which serve to high-light rather startlingly some of the variables that otherwise would go unnoticed. Good.

The first thing you'll notice, as the Toccata ends and then begins once more, is the extensive, if subtle, differences between organs, within the framework of a single tradition and sound-style. Second, you'll hear acoustics differing sharply from relatively dead to ultra-live, and you'll begin to understand how intimately the organ and its acoustics are bound up with one another.

Next you'll suddenly begin to realize, as Biggs begins this same piece again and again, that he is *playing for the acoustics*, in each hall, that he waits deliberately for the reverberation to die to a certain point before coming in with a following passage, that he gauges the tempo to the reverberation, registers the pipes so that the details come through best in each acoustic situation. The various versions are, indeed, quite unlike each other, in ways that are abundantly clear and enjoyably evident to the listening ear.

A good lesson for us here. Orchestral conductors do the same; even pianists. But in such cases there can be very little physical change of tone color in the acoustic adaptation. Nevertheless, if we had, say, the Amsterdam Concertgebouw on tour, recording the same piece in 14 different halls, you would without the slightest doubt hear a similar variation in performance, the conductor playing up to the acoustics quite literally phrase by phrase.

And finally, to return to Biggs, you will discover with a slight start, I think, that old Bach, too, was playing directly for his acoustics. The old bird knew his organs! The Toccata is most remarkably well written to take advantage of die-away time as a dramatic force. Why else the many sudden pauses, why else the fancy solo flourishes between chords, the arpeggio figures that blend into dynamically moving harmony (like a transient wave form, never fixed but always in the process of change)?

As you become familiar with the Toccata you'll hear that Bach even wrote those flourishes and furbelows in such a way that *in each of them the preceding harmony is still implied*—and can be carried over as an actual die-away echo, blending with the flourish itself. You adjust your playing tempo to fit the echo. And you time your dramatic pauses too, allowing the reverberation to die away into the last far corners of the huge building (or so it seems) before going on to the next harmony. All this Bach intended, and in each of the 14 versions of the music Mr. Biggs plays a shade differently, with his ear closely tuned to the building itself. That is proper organ playing.

As for the "Hi-Fi Adventure" aspect, the sound is beautifully captured and presents great variety, as well as a good deal of solid bass. High-quality engineering rates a hi-fi encomium all right. But in the end, the above musico-acoustical points will be your primary interest in the listening. After all, good fi is, and ought to be, a means to an end.

The King of Instruments, Vol. IV: Hilliar at St. Mark's. (Mt. Kisco, N. Y.) Aeolian-Skinner Organ Co., Boston 25, Mass.

This series, like the Möller series (below), is an organ-builder's project, recorded and sponsored by the makers of the instruments themselves. The basic intent, thus, is to demonstrate the company's instruments.

But to whom? There we find the usual problem. Here we have a particular organ, that of Saint Mark's at Mt. Kisco, and a featured organist, Mr. Hilliar. (Earlier "King of Instruments" performers were in part anonymous). Good—two solidly fixed factors, making for clarity and organization on the disc.

There remains the music and the playing. Mr. Hilliar's program is unexpected in that all but one of the works come from the great period of 17–18th century organ music. The one, by still-living Marcel Dupré, stands out rather startling from the rest of the disc, which features Bach, Pachelbel, Loeillet, Arne, of earlier times.

I find the Hilliar playing of Bach *et al* rather deliberate, ultra-careful, especially in the ornaments which are "spelled out" note by note as though Hilliar were following a rule book. On the whole a bit stodgy and unimaginative, though the registrations are very nice and the ornaments are technically correct. (But how about the double-dotting that is lacking in the big Couperin organ Mass?)

Recording is technically gorgeous but, for my taste, a bit too clinical and close-up. Understandable in view of the company's special interest in the instrument itself.

Music for the Organ, Vol. II, M. P. Möller, Inc. The Geo. Washington Memorial Shrine, Alexandria; the Double-Ariste Organ. Edward Linzel, Ernest White, organists.

Another organ company, offering the sound of a huge organ (Washington Memorial) and a relatively small one—and the contrast is perhaps not just what the company intended. The "small" organ makes the most noise in these records!

It's not easy for those who are unfamiliar with records to keep in mind that there is no such thing as absolute volume in recording. Instead, there is absolute recording-level, which is roughly the same regardless of sound source, whether the sound is a cricket or an atomic bomb. What has happened here is simple enough. The level being more or less fixed (on the average) by the recording requirements, other factors have raised their intriguing heads to distract our attention. The small organ, for example, was bound to be recorded at a closer mike range than the big one. Its acoustical surroundings are, naturally, less enormous and less alive. Thus the small-organ sound is much sharper, edgier, the dramatic contrasts between full volume and *pianissimo* more literal and more extreme, as recorded.

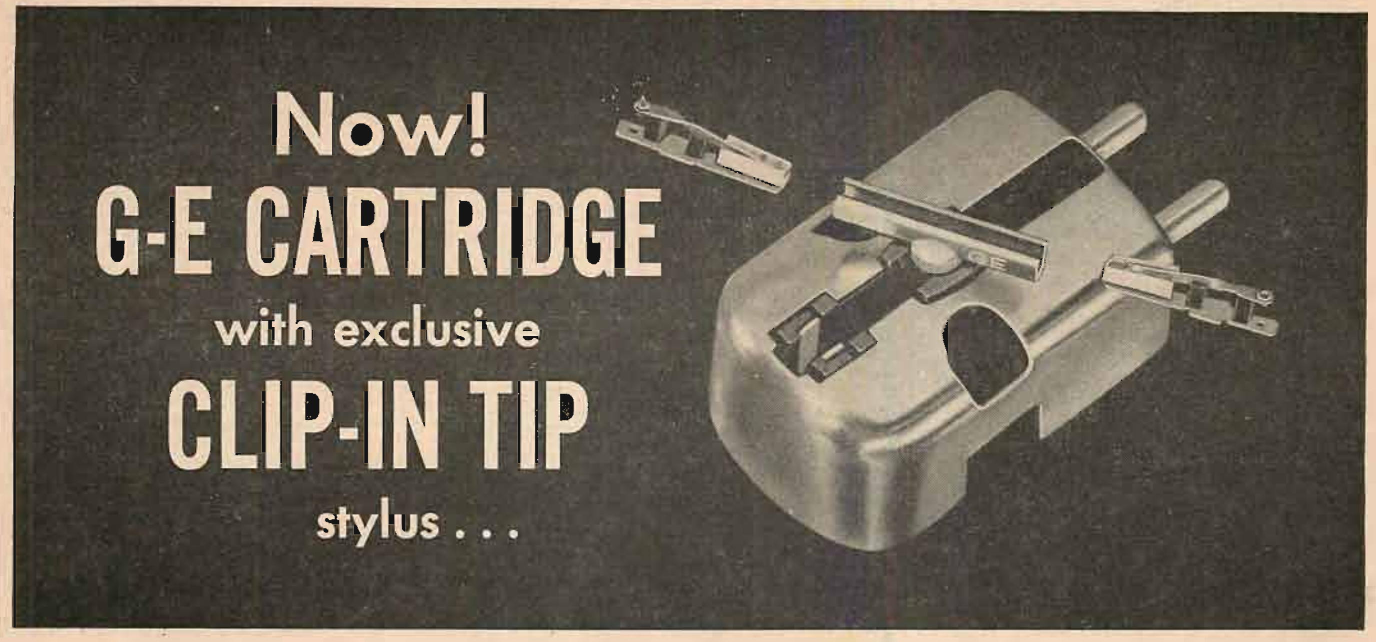
The big organ, a whopper in a huge hall, is heard at a distance and with vast reverberation. The music is ultra-clear—thanks both to the organ builders and to Edward Linzel, who does the playing and chose the registrations. But the sharp edges are mellowed and blurred, the contrasts in volume comfortably rounded off, the whole softened and toned down.

Result: the "big" organ sounds with a velvety-

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

sound. See below for its successor.
And in case you think I'm an organ snob,
too, was playing directly for his acoustics. The
old bird knew his organs! The Toccata is most
Another organ company, offering the sound of
a huge organ (Washington Memorial) and a

SAVES TIME...MONEY...RECORDS



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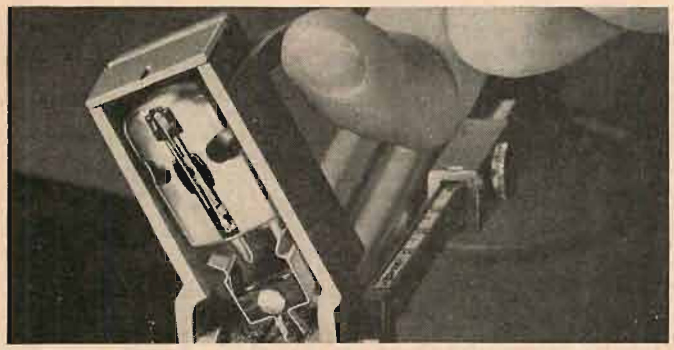
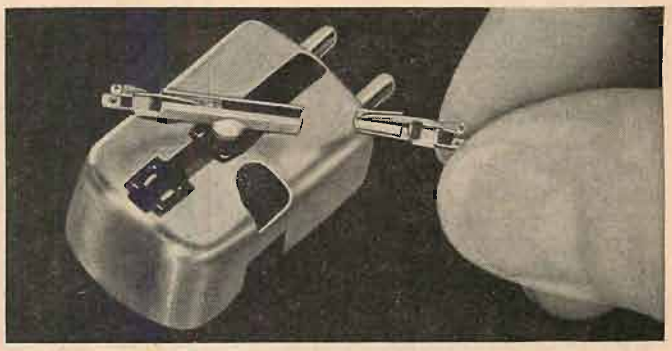
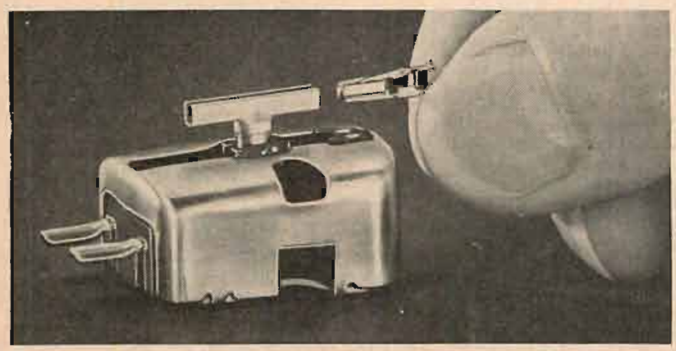
General Electric Company, Radio & TV Department, Section R4495, Electronics Park, Syracuse, N. Y.



Simply raise the tone arm sufficiently to permit free rotation of the CLIP-IN TIP stylus. No more effort than is required when changing from 78 to LP playing position.



The worn stylus insert slides out easily and you insert a new one in its place. That's all with a G-E CLIP-IN TIP. Needs no diagram . . . requires little effort . . . little time.



New single styli have this feature, too. Just raise the stylus shaft . . . replace the insert. A CLIP-IN TIP can be used in existing G-E dual cartridges or new single and dual types.

GENERAL ELECTRIC

smooth and rather gentle effect; whereas the "small" organ, all edge and closeness, will blast you out of house and home if you're not careful. It was too much for a not-too-compliant stylus I was using.

A consistent musical program—an organist's pot-pourri of this and that and the other. As might be expected, the organist's composers, Vierne, Reger, Widor, (the eternal Three of the organ-playing profession) sound the best. Definitely not a record for the general music lover, nor yet much of a hi-fi record, thanks to conditions mentioned above.

César Franck: Three Chorals for Grand Organ; Prelude, Fugue et Variation. Ernest White, organist. **Discuriosities BCL 7280**

Here we have a performer and a composer featured (on a Möller organ). Ernest White, who also plays in the Möller recording above, is an expert and experienced organist of wide knowledge and virtuoso technique, but, for my ear, a hard player whose authoritative performances are often rhythmically tense and inflexible, whose registration is on the steely, ultra-brilliant side.

César Franck is, of course, of the opposite temperament as we all know from his music—a gentle, soft-hearted, cloistered little man whose music soars with the utmost poetic honesty if sometimes at too-great length and diffuseness. These mild but lengthy chorals, free variations or fantasias, rather, on sturdy and typically Franckian themes, can be played with poetry and atmosphere; here they lack both. Hard, dogmatic registration, inflexible tempos, impart a chrome-plated taste to music that should be all honey and malted milk.

Robt. Elmore: Rhythmic Suite; Rhumba. Boellmann: Ronde Francaise. Roger-Ducasse: Pastorale. Edward Linzel, organist. **Discuriosities BCL 7201**

Mr. Elmore's Suite for my ear is all noise and precious little music. Here we get into organists' music for a fare-thee-well—that the professional organist loves to produce on a powerful instrument (and the organ composer too). A lot of people like the sound, I guess, but to me it's as dry as dust. The other works are musically more accessible though I'd hardly expect them to rate as first-quality music outside of the organ world. This one is a genuine organist's organ record.

John Harms Plays Bach Chorale Preludes and Other Works. Unicorn UN 1004

Here is another approach to the organ record, from the new Boston-based Unicorn company. Harms is not only an organist but also conductor of a well-known chorus carrying his own name.

The two sides of the record are musically consistent, one of Bach, the other of recent music of the neo-Romantic sort. The organ sound here is fruitier, more gentle even in the loud parts, than that of the Discuriosities recordings preceding and Mr. Harms shows himself as an excellent and musical player of this juicier sort of organ literature, as exemplified by the works on his Side 2. (Only the last piece, a "Carillon" by Vierne, lets go with these typical organ roarings and thrashings-about.)

The Bach on Side 1 is more problematical. The playing is, somehow, that of the good professional keyboard man at work on a problem in registration and finger-technique—the notes are all present, the sounds are appropriate, but the spirit that some of us recognize in old Bach is missing. Mr. Harms evidently doesn't hear these works as the "big" pieces, the profound expressions, that they can be.

You'll find the same thing among pianists who play the "Well Tempered Clavier" preludes and fugues or the Bach Inventions as though they were competent academic finger exercises—which, oddly enough, they are. But they are much more than that, too, and so also are these chorale preludes elaboration-variation on hymn tunes and on the emotions expressed in the texts of the tunes. "Out of the Depths I Cry to Thee," for instance. Not exactly a subject for a finger exercies.

In line with this somewhat professional attitude, the Harms Bach ornaments—the added dissonances, turns, trills indicated by special signs—are consistently incorrect from beginning to end, distorting the musical sense of the playing (whereas Hiliar's, in the "King of Instruments" disc are laboriously correct, right out of the book.). Like a good many keyboardists who don't specialize in Bach and his time, Mr. Harms evidently isn't especially aware of their musical importance.

Johann Pachelbel: Toccatas, Fugue and Chorale Preludes.
Joh. Gottfried Walther: Concerto and Chorale Preludes. Luther Noss, Holtkamp organ, Yale Univ. **Overtone 8**

Here's an organist who has progressed beyond the organ pot-pourri, beyond the collection of one or two big composers, into the specialty range: two less-known (but big) men of the Bach period, back in the early 18th century. But the odd thing is (and it doesn't surprise me a bit) that the resulting sound is a good deal more easily listenable for the average music-lover than the organ records that wrench you violently from one style to another, one type of music to another type utterly unrelated. Who ever first put over the idea that the pot-pourri made for easy listening!

The good reasons why this disc can grow on you without too much trouble are: (a) There are only two composers, two personalities, to get introduced to, and both are from the same background and time. (b) They knew their musical business very, very well. (c) Mr. Noss, the organist, knows his—knows the music, the composers and the background as well as how to play with feet and fingers. (d) The machine is a good one, and well recorded.

Of the two sides, the Pachelbel side is the best for listening. He's a bigger, more dramatic composer, although earlier, and his music lends itself better to brilliant, jolly tone colorations, Herr Walther, a contemporary of Bach, is a milder, less imaginative composer (at least in these works), tending to the academic in a nice sort of way. Seems he was a celebrated lexicographer as well as an organist-composer, which might account for it.

Actually, this Holtkamp organ is two organs in one, in the transept and the apse of the Battell Chapel at Yale (1951). The first three Pachelbels on Side 1 are played on the apse organ and I like the sound better than that of the rest of the disc, made on the transept division. Maybe it's the recording, which in the apse seems nearer, more apt for hi-fi sound, or in the organ itself and the registration, which is highly colored and full of variety in the apse recordings. This part of the record is really first rate and a wonderful aural entertainment. Try Band 2 for one of the jolliest, most good humored, un-Bach-like fugues you'll ever hear.

The Mighty Wurlitzer Pipe Organ. Gordon Kibbee, organist. **Starlite ST 7002**

Here it is! The gorgeous, fat, multi-colored theatre organ, 256 stops including a real brass trumpet and a sax section and a real piano (played, we can suppose, by remote control), plus the usual belly-jiggling vibrato, the harps and chimes and steam calliopes . . . phew!

There's only one trouble with my copy. It arrived so badly warped that the pickup skips every other groove, and the cover was ripped open on three sides . . . but it really didn't matter much; I got the general idea easily enough by putting a weight on the pickup. Such sounds as you can hardly believe (unless you're an old-time moviegoer) whole orchestras of "real" brass, crashing chimes that make you jump, wondrously nasal snorts and grunts, pulsing melodies, a new stop and a new sound every few seconds.

Arrangements in the "modern" (i.e. radio) manner of everything from "Pal Joey" and "You Mustn't Kick it Around" and each and every one is a gem of theatre-organese, the pure and windy power stuff that is fast vanishing today before the pale onslaught of electronics. Hi-fi? Absolutely terrific.

* * *

Quite honestly, aside from the very special Biggs Toccata in D Minor fourteen-fold, the only two records in the above batch that I *really* enjoyed (and would have acquired on my own) are these last two, poles apart. On the one hand, Pachelbel & Co. from 18th century Germany and on the other, the Mighty Wurlitzer. It's a funny world.

2. Looking 'Em Over—Decca

Decca's current output, largely from European imports of a wide variety and appeal, makes an interesting contrast with that of M-G-M surveyed last month, which is recorded exclusively in the U. S. These represent two opposites in policy; most companies combine European imports with American-made recordings.

(*Continued on page 50*)

tuning, FM di-pole antenna, etc.
ings-about.)
The Bach on Side 1 is more problematical. The
snorts and grunts, pulsing melodies, a new stop
and a new sound every few seconds.

New Top Quality **KNIGHT** *Hi-Fi Components*

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This superb new amplifier is housed in a beautiful space-saver metal case finished in attractive cork-grain with gold-tone control panel. Only 4 x 15½ x 11". Shpg. wt., 30 lbs.

94 SZ 701. NET only.................... **$94.25**

New Knight Deluxe Basic FM-AM Tuner

- "Lock-in" FM Tuning (AFC)
- Tuning Meter for FM & AM
- Sensitivity: 5 Mv for 30 db quieting on FM; 5 Mv for 1.5 volts output on AM
- Tuned RF Stages on FM & AM
- FM Discriminator With Double Limiter
- 2 Cathode Follower Outputs—Detector and Tape Recorder

Circuit includes 11 tubes plus rectifier. Matches Deluxe Amplifier; in attractive cork-grain finished metal case with gold-tone control panel. Size: 4 x 13½ x 10". Shpg. wt., 17 lbs.

94 SX 702. NET only.................... **$94.50**

New Knight "Bantam" 12-Watt Hi-Fi Amplifier

only $61.95

- 3-Position Record Compensator
- Variable Damping Control
- Loudness Control
- ± 0.5 db, 20-20,000 cps
- 6 Inputs
- Built-in Preamp

Maximum value in a versatile, top quality amplifier. In handsome case, with smart cork-grained finish. "Space-saver" design, only 3½ x 13 x 10½". Shpg. wt., 14 lbs.

94 SX 700. NET only.......................... **$61.95**

New Knight "Bantam" Basic FM-AM Tuner

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- "Lock-in" FM Tuning
- Latest 7-Tube Circuit
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A perfect match for the new "Bantam" amplifier, in beautiful cork-grain finish metal case, only 3½ x 11½ x 9¼". Shpg. wt., 10 lbs.

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New Knight "Uni-Fi" Tuner-Amplifier Combination

- Single Chassis Construction—Simple To Install
- Complete FM-AM Tuner—Preamplifier-Amplifier
- Compact Styling—4⅜ x 15⅛ x 11⅛"—Fits Anywhere
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- 10-Watt High Fidelity Amplifier With Every Advanced Feature

The logical high quality complete ensemble for limited-space applications; an ideal replacement for obsolete equipment in existing cabinets. Available in cabinet illustrated or in chassis form (4¼ x 15 x 10½").

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AUDIO ETC.

Edward Tatnall Canby

The Home-Grown Tape Program

Back in 1943 I started a weekly radio program, on a war-time FM station in New York. Not many people heard it—on the old FM band—but that didn't make the job of putting it on the air any less demanding.

The first show I cooked up, on mood music, required 25 different 12-inch 78 rpm records in about 28 minutes and the lady engineer with whom I was to work went on strike in a huff. After a two-week delay I managed to reduce the tonnage to something like 20 discs and she reluctantly went along—and from thence foreward I never turned out a show with less than a dozen or so tricky recorded cues. It didn't take long, either, to find out that you could mix and blend and overlap records in some odd and wonderful ways—*if* you could get the idea over to the engineer who was to do the mixing and blending.

I had two lady engineers on that station. (The first one blew her top every other rehearsal and, first thing we knew, she'd gone off and got married.) In '46 I shifted to a "real" station, New York City's own WNYC, and there, with occasional interruptions, I've been ever since, splitting the difference between AM and FM. I soon found that the politic way to get along, with my crotchety ideas, was to bring in my own assistant from outside to do the real dirty work—the mixing and fading—and this system proved fine for all concerned, especially the WNYC engineers who, after all, had very few trained musical minds between them, nor was there any reason why they should.

And so—to the point for this month. After a few years I began to lose weight. Good part of a week's work at home on the script and the music cues, translating them into lines and cross-marks on the records and into musical descriptions that would make sense to my assistant and to the cooperating engineers; then, of a Sunday morning, a hectic hour or two of concentrated last-minute persuasion while I tried to teach the cues to those who were going to have to carry them out—and we were airborne.

I was helpless from the moment we got on the air, and could only pray for luck, and make oh-so-casual excuses when the wrong side of the record was played or a 78 disc started off at 33-and-a-third. It happened—too often.

I began to get gray hair and my assistants took to having hysterics and lapses of memory, as my shows got complicateder and complicateder. I had no less than three (male) in the culminating years of the 78 record, and all were crackerjack, and got better and better, too, as we practiced our musical sleight-of-hand, until the memory lapses began. It got so we seldom had less than two records playing simultaneously and by that time I had charts and diagrams—not only turntable speed and exact cue to the millisecond, but equalization setting *and* level for every record so the volume and tone-quality would match up correctly; and there were times when, to match the pitch of two records we had to lean gently on the edge of one table to slow it down at the crucial moment . . . anyhow, just as my assistants and myself were about to crack wide open under the strain—Jackie Gleason has nothing on us —along came tape.

Tape to the Rescue

To be sure, I had made some slight use of disc recording, at times when I couldn't do a show in person. The studio would disc-record a series of short spoken passages by me, which would be played between slices of recorded music. Introductions and comment. But no tricks—not on a studio disc recorder! And quality was no better than could then be expected. My voice never did take well to disc recording, having no announcer-style mid-frequency "punch" or projection, and I used to shiver when I heard the travesty of myself that came forth, from those piecemeal 16-inch transcriptions.

We didn't transcribe the music—that would have been unthinkable. Quality deterioration, commonly described by the term "dub," as then used.

It must have been along about 1950—so long ago!—that I tried a few "cuts" on the new studio tape equipment, just installed, and was much gratified. And about that time I got the tape bug and began thinking about a home-grown show, to be done in my own "studio." I even got around to trying one. But the combined room noise, background hum, distortion, misequalization and what-not added up to something I prefer not to remember! Bless WNYC for forebearance and patience; I wasn't thrown off the air and so my show lived to see better days, as to audio.

Those better days began when this mag and myself launched a version of the same show that proved to be a bit ahead of time as far as most small radio stations were concerned—who would have thought, then, that radio would ever turn to classical music and to classical records?—but which marked a big step forward for me, intermediately.

For, at last, I did the show at home, with an assistant, the same who did my WNYC show (which continued in its "live" form). It was taped, beginning to

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

STYLUS-BALANCE
". . . this really works . . ." Canby
After a few years I began to lose weight. Good part of a week's work at home on
It must have been along about 1950—so long ago!—that I tried a few "cuts" on the new studio tape equipment, just in-

end, this show. But—and this really amazes me now, as I think back—the entire procedure was borrowed direct from the "live" show, complete with mixed records, cross-fades and all the other Canby tricks, already known (to the Canby trade) as phonomontages.

It never occured to me, then, that tape itself would allow me to develop new tricks, to the point where I could dispense entirely with an assistant, and dispense in consequence with a multitude of other former necessities, such as script directions, record markings, timings—and even the script itself! I had to learn.

And so, with the invaluable aid of editor McProud (whose basic equipment I still use, week in and week out, to this day), we set up a "live" show, so to speak, in a back room in my apartment. Soundproofing made of coarse rug-protecter matting (Ozite). Two Rek-O-Kuts in portable boxes, a McProud mixer and a WE cardioid mike, feeding into my tricked-up Magnecorder. A budget job, and intentionally so; my program is still of the budget sort and I wouldn't have it any other way for the world—though at this point the taped results are, I dare claim, of professional quality. I'm no Bing Crosby Enterprises, nor yet again Les Paul and Mary Ford. My entire equipment can be dismantled and moved, by one person, and set up in another room within an hour or so—I've done it twice already this year. I like it that way. It's fun. And when you get good results, you are that much more pleased with yourself.

Look and Listen

Perhaps I should flash back, for a moment, to a scheme that had occupied me earlier in the game for a couple of years. 'Way back in the early postwar era, I got the idea of a radio program about records given in the form of a "live" lecture, with record-playing equipment, mixers, loudspeaker, mike and, of course, assistant-with-script, all in plain sight of the audience. I worked up several portable outfits of this sort and gave quite a number of assorted lectures, from script, with records cued in exactly as in my air show.

The most successful of these, you may well imagine, were those in which said assistant was a lady, and dressed in a fetching red or black gown. She had lovely black hair and she went beautifully against all sorts of backdrops—very ornamental. The spectacle of such a creature enmeshed in earphones (we had a record cue-up device, of course), snapping switches, precuing records, doing quick flips in seconds flat (record flips), was, indeed, so intriguing, that my lecture sort of got lost in the shuffle. But we ventured as far away as New Haven, Conn. and Pottstown, Penna., as well as into a number of New York convention meetings, before the idea went by the board.

This was, of course, the basis for my first home program on tape. We virtually duplicated my lecture equipment, in more modern form, even to the cue-up device via earphones.

Why did I stop the radio-style lectures? Very interesting. Because of what might be called psychological factors. There were too many distractions. The excitement of the equipment (sprawled all over the lecture stage with wires running here and there like a TV show) and the deft operations with records was, indeed, a show in itself and kept people's concentration off the listening part. Fine—but a lecture without a lecturer wouldn't have done much good

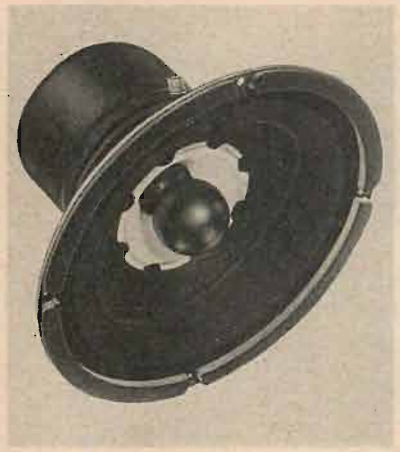
(*Continued on page 60*)

device, of course), snapping switches, precuing records, doing quick flips in seconds flat (record flips), was, indeed, so intrigu-

2. Pushbutton Manual Record Player

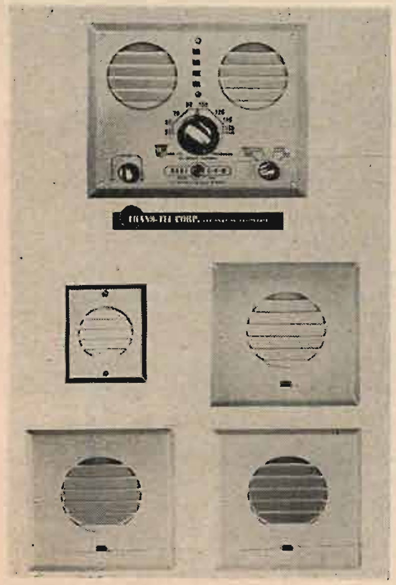
NEW PRODUCTS

• **Japanese Hi-Fi Speaker.** A small globe-like structure centered in the tweeter cone is easily the most unique among a number of unusual features incorporated in the new Model 8P-W1 Panasonic 8-in. speaker recently introduced in this country by R. I. Mendels, Inc., 41 E. 42nd St., New York 17, N. Y., North American representatives of Matsushita Electric Industries, prominent Japanese manufacturer of electronic products. Use of the globe is said to provide improved distribution of high frequencies. In construction, the Panasonic



has separate tweeter and woofer cones, coaxially-mounted, with a mechanical crossover. The woofer cone is treated with a patented elliptical corrugation to reduce resonances, and varies in both density and thickness from apex to edge for maximum compliance. The voice coil is wound of aluminum wire. Impedance is 7.3 ohms at 400 cps, and frequency response is 40 to 16,000 cps. **S-9**

• **Intercom-Music System.** Both music distribution and intercom functions are performed by the new Radi-O-Com system introduced primarily for home use by Trans-Tel Corporation, 736 N. Highland Ave., Hollywood 38, Calif. The assembly consists of a master unit in which is incorporated a 6-tube superheterodyne re-



ceiver, three remote speaker panels, and a speaker for front door installation. All units contain permanent-magnet speakers as well as microphones for complete two-way intercom operation. Components have been designed to fit between studs in new home construction and for surface mounting in existing houses. Picture-frame-type enclosures for remote speakers are available. **S-10**

• **Lightweight Low-Cost Microphones.** Suitable for paging systems and general purpose work as well as for home recording, a new series of American microphones offer good audio performance despite their small size of 3¼" x 2⅛" x 15/16" and weight of but 2 oz. They are available with either shielded crystal or ceramic elements. The crystal type has a response of 100 to 7000 cps with output of −55 db; the ceramic element frequency range is

100 to 6000 cps with output of −62 db. Impedance is high in both types. They are omnidirectional and are available in either gray or beige. Additional information available from American Microphone Company, 370 S. Fair Oaks Ave., Pasadena, Calif. **S-11**

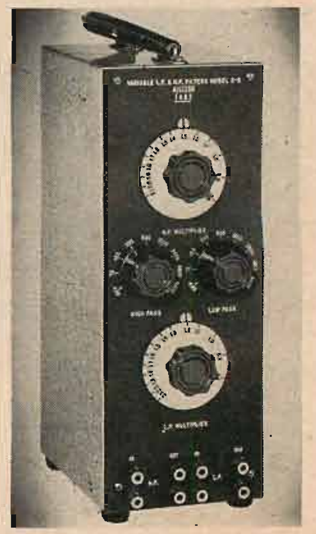
• **Two-Channel Tape Recorder.** Newest in the series of Educorder two-channel magnetic tape recorders manufactured by Educational Laboratories, Inc., 1823 Jefferson Place, N. W., Washington 6, D. C., is the Model M-7, a compact unit which occupies no more space than conventional single-channel recorders. The new machine delivers nearly five watts output from each channel. It uses spaced heads with proper spacing for playback of recorded commercial binaural tapes, and can be used to make its own binaural recordings. Provision is also made to permit use of the second channel to control an automatic projector, causing slides or strip film to move in synchronization with recorded

lecture material on channel one. The unique feature of being able to listen to one channel while recording on the other provides one of the recorder's most common uses. A student working by himself with the machine listens to recorded master lessons on Channel 1, and during pauses provided in the lesson material provided for the purpose, uses channel 2 to record his own response or imitation of the drill material. When the lesson is completed, he plays back through split head phones which give him the master lesson in one ear and his own response in the other, thus permitting direct comparison and self-evaluation of his progress. Further information will be supplied on written request. **S-12**

• **Hi-Fi TV Speaker System.** A line of two-way speaker systems in convenient table form, designed to improve the sound quality of table-model TV receivers has recently been introduced by Jensen Manufacturing Co., 6601 S. Laramie Ave., Chicago, Ill. The TV Duette replaces the small, side-mounted speaker in most table-model TV sets, resulting in greatly increased audio frequency range and improved realism because the sound coming from the front is "picture centered." Two positions of a three-position switch permit instant comparison of the Duette with the original TV speaker, while the third position may be used to operate the Duette in conjunction with a hi-fi music system. Four TV Duettes are offered in Models DU-500 and DU-400. DU-500, with com-

pression-driven horn-loaded tweeter and 6" x 9" oval woofer, is available in blonde oak with brass-plated hairpin legs and ribbon-striped mahogany with brass-ferruled wood legs. DU-400 is more modestly priced and may be had in Korina blonde or mahogany finish printed on wood. It is equipped with a direct-radiation tweeter. **S-13**

• **Metalphoto Corporation,** 2903 E. 79th St., Cleveland 4, Ohio, has available a comprehensive four-page report detailing technical aspects as well as many new applications for the Metalphoto process of photographic reproduction on photosensitive aluminum plates. The free literature illustrates and describes the Metalphoto



manufacturing process, and covers in detail the formation and structure of the anodized layer of the plates in which the legend to be reproduced is imbedded. It is this feature that provides these plates with their high degree of permanence. **S-14**

HARVEY the House of Audio

The NEW FISHER MASTER AUDIO CONTROL

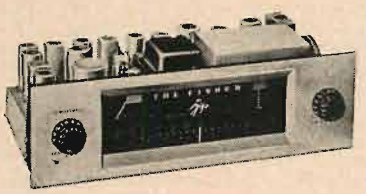
Model 80-C

Professional, lever-type equalization for all current recording characteristics. Separate equalization and amplification directly from tape playback head. Complete mixing and fading on up to 5 channels. 7 inputs, including 2 Phono, Mike, and Tape. Separate high-gain microphone preamp. Push-button channel selectors with individual indicator lights and simultaneous AC on-off switching on 2 channels for tuner, TV, etc. Variable-crossover feed-back type bass and treble controls. Loudness balance control. Master volume control and 5 independent level controls on front panel. 2 cathode-follower outputs. Self-powered. 4 dual-purpose shielded and shock-mounted tubes. DC on all filaments achieves inaudible hum level, non-measurable inherent hum, IM and harmonic distortion. Frequency response uniform from 10-100,000 cycles.

Chassis only, complete with tubes $99.50
Mahogany or Blonde Cabinet 9.95

The FISHER FM TUNER

Model FM-80



Most efficient! With **TWO** meters — one to indicate sensitivity, one to indicate center-of-channel for micro-accurate tuning. Armstrong system — 2 IF stages, dual limiters, and cascode RF. Full limiting down to 1 microvolt signal. Exclusive dual antenna inputs — 72 and 300 ohms, balanced. Sensitivity 1½ microvolts for 20 db quieting on 72-ohm input, 3 microvolts on 300-ohm. Entire chassis shielded and shock-mounted to eliminate microphonics. Three controls—Variable AFC/Line-Switch, Sensitivity, and Station Selector PLUS an exclusive Output-Level Control. Two bridged outputs of low-impedance, cathode-follower type, permitting output leads up to 200 feet long. Eleven tubes. Self-powered. Beautiful, brushed-brass front panel. Chassis size 12¾" x 4" x 8⅛", including control knobs.

Complete with 11 tubes and dipole antenna, Chassis only $139.50
Mahogany or Blonde Cabinet 14.95

The NEW FAIRCHILD

Model 255

25 WATT POWER AMPLIFIER

The *ideal* power amplifier for the average home or apartment, it has been particularly designed for high-quality reproduction of music and all other types of program material. Featuring excellent transient response and unusually low distortion at normal and low power operating levels, the 255 delivers full power throughout the entire audio-frequency spectrum, not only to a resistive load, but also to a speaker load which is, of course, the load presented to it in ordinary use. Features are as follows: Full 25-watt output with 0.9-volt input. Controlled frequency response from 20-20,000 cps, +0, —0.5db. IM distortion under 2% at 25 watts, under 0.5% at 22 watts, under 0.2% below 15 watts. Harmonic distortion under 1.0% at 25 watts, under 0.2% at 22 watts. Noise is more than 80db below rated output. Exclusive balance control gives proper output — tube balance without test equipment. Fixed selenium-rectifier bias supply. 5 tubes.

Complete with tubes $89.50

NOTE: Prices Net, F.O.B., N.Y.C. Subject to change without notice

AMPEX 600

PORTABLE TAPE RECORDER

A high quality tape recorder designed for professionals: broadcasters, recording studios, and other critical users. Housed in a truly portable case, the entire unit weighs less than 28 lbs. The quality of performance of the 600 is identical to the console model 350.

Has separate erase, record and playback heads . . . and separate record and playback amplifiers. A direct-reading meter permits continuous checking of recording level. Tape speed is 7½ inches/sec. with a frequency response from 40 to 10,000 cycles ± 2db , and to 15,000 cycles ± 4db.

Other features include:

•Signal-to-noise ratio: more than 55 db • Flutter and wow: less than .25% • Fast forward and rewind: 90 seconds for 1200 feet • Microphone input: high impedance • Line input: for high level source (.5 volt level) • Separate level and mixing controls for microphone and line inputs • Monitoring: through phone jack or playback output • Playback output: 1.25 volts into 10,000 ohm load (matches input of most amplifier systems) Recording distortion is negligible. The Model 600 is extremely easy to use. Only one hand is needed to thread the tape. Can be operated either vertically or horizontally, and is readily adaptable for installation in home high fidelity systems.

Complete with tubes, less microphone $545.00

AMPEX 620

PORTABLE AMPLIFIER-SPEAKER SYSTEM

Designed as a companion piece to the Ampex 600 Portable Tape Recorder. Weighs approx. 19 lbs. case included, and measures 13 x 16 x 8". Employs a 10-watt amplifier with push-pull output, and less than 1% total harmonic distortion. Frequency response ranges from 20 to 20,000 cycles ± .25db. Speaker is housed in built-in acoustically matched enclosure. An external speaker jack is also provided. Power supply is built-in, and front-panel controls included for volume level, equalization and power. **Complete** with tubes $149.50

The New MIRACORD

Model XA-100

RECORD CHANGER

Embodying many innovations, the Miracord features the 'Magic Wand Spindle' designed in such a manner that at no time does it support a load greater than one record. Four push-buttons provide wide control flexibility. The **START** button also acts as a 'reject', for the purpose of switching to the next record. A **PAUSE** button permits a variation in the change interval between records: from 5 sec. at 78 rpm to 328 sec. at 33⅓ rpm. The **FILTER** button introduces a 'scratch filter' that suppresses surface noise of old records. The **REPEAT** button replays the whole or any part of a record.

Both the turntable and arm are mounted in double ball-bearing races. A hum-shielded 4-pole motor further reduces vibration rumble and 'wow' to an inaudible minimum. Plug-in heads accommodate most standard pickup cartridges. A single-play spindle is also furnished which may be used for repeating a single record, over and over.

Complete with 6' line cord and 4' phono cord $67.50

Hi-Fi Special

Famous Imported Output Tubes

MATCHED KT-66's

for Balanced Push-Pull Operation
Replace: 6L6, 1614, and 5881 tubes — per pair $6.95

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Model 255
used for repeating a single record, over and over.

RECORDS

(from page 44)

The danger in an all-European outlet is that the organization on this side of the Atlantic may tend to atrophy into a mere distribution setup, leaving the heavy work, the initiative and the know-how to the foreign end of the connection. More than one company has gone through a local hell when policy suddenly called for renewed domestic original recording, after a long session with the opiate-like flow of pre-fab European jobs, ready for the market.

But, so long as the European flow keeps up, we customers get it easy, and Decca's classical repertory is a fabulous one right now. (Some chamber works seem to be recorded in this country, as well as the Little Orchestra, the Zimbler Sinfonietta.)

Mozart: Violin Concerto #5, K. 219 ("Turkish") Saxon State Orch., Konwitschny. **Symphony #32.** Bamberg Symph., Fritz Lehmann. **Decca DL 9766**

Decca's contribution to the growing list of Oistrakh records—see also the Brahms and Tchaikowsky concerti. A first-rate performance by a wonderful musician, rather on the sweet, melting side as compared to the more glittering and glassy Mozart now often heard. Symphony #32 is one of those written in the Italian "sinfonia" style, three movements played continuously as a piece; glossy, bright-toned music quite unlike the mellower Austrian-style Mozart that is most familiar to us.

Virtuosi di Roma vol. 4: Music of Vivaldi. Decca DL 9729

This group compares with the similar "I Musici" on Angel and RCA's Societa Corelli—all small groups of chamber players, usually less than a dozen, who do the 18th century concerti in an almost chamber style, amplified, however, by spacious recording. The Virtuosi group has good taste. Among the hundreds of Vivaldi concerti these are certainly outstanding. Four here, one of which is ultra-familiar (and played without much imagination) and another, "Il sospetto" is a major find and a splendid work powerfully played. A fine record of its type.

Mozart: Serenata Notturna in D, K. 239; Six Notturni for Voices and Woodwind; Piano Concerto #14 in E Flat, K. 449. Grete Scherzer, pf.; London Baroque Ensemble, Haas. **Decca DL 9776**

The London Baroque group did recordings for Westminster, but of Bach; here they turn to the later (and not really Baroque!) Mozart. The Nocturnal Serenade is pleasantly light Mozart background music; the six Nocturnes for voice are unusual short items, for voices accompanied by a clarinet and a basset horn (mid-range clarinet); the piano concerto is not only lovely but most gracefully and refreshingly played. Excellent. Some distortion in the Parlophon recording; the Concerto has the least.

Irmgard Seefried Concert. (Hindemith: Geistliche Motetten. Mozart: Overture, aria from Il Re Pastore, "Non Temer", K. 490.) with Vienna Symphony, Leitner. Erik Werba, pf. **Decca DL 9768**

This one, from Deutche Grammophon, features the outstanding German soprano whose German songs (with piano) are superb on two earlier Deccas, especially the second, of Wolf and Brahms. She sings the Hindemith here with fine energy and expression and with excellent diction (with piano) but, perhaps due to mike placement, the orchestral works of Mozart find her seemingly poor in diction and she seems a bit listless in expression. Hard to say why, but I suspect the trouble is not in the voice but in the mike placing, which in the Mozart puts her peculiarly off-mike. No texts provided for all these—a big mistake. A high, thin, pure voice of really lovely quality and musicality.

turnal Serenade is pleasantly light Mozart background music; the six Nocturnes for voice are unusual short items, for voices accompanied by a

Mozart: Piano Concerto #26 in D, K. 537. Carl Seeman; Berlin Philharmonic, Lehmann. **Concert-Rondo #1, K. 382.** Seeman; Bamberg Symphony, Lehmann.
Decca DL 9631

More Mozart—Decca, like everybody else in Europe, is heading into the Mozart year of 1956, his 200th birthday year. This late-Mozart concerto is done with a big ("symphony") sound, not as intimate as the London Baroque above, more suave, faultlessly tailored but a wee bit uninspired in a very proper way. Just a trace—now you hear it now you don't. Mozart concerti so easily fall into this! A lot better than a loud or crude or cute performance, I must say.

The Concert-Rondo, thrown in for extra, is a pat and sweet set of variations. Some comments. Not an outstanding disc, just a good and proper one.

Schumann: Symphony #4. Haydn: Symphony #88. Berlin Philharmonic, Furtwängler.
Decca DL 9767

It's seldom that a conductor, even a famous one of long experience like Furtwängler, can put heart and soul both in a Schumann and a Haydn. Here, it is the Haydn that suffers a softish, undramatic playing; the Schumann, in spite of a somewhat heavy-handed and *echt*-German approach (and why not?) has the very sense of drama, the feeling for key changes, for moods, for points well made, that the Haydn signally lacks. Not a good pairing.

This Schumann 4th, nevertheless, is a welcome change from too many hard, hacked, over-fast, over-jerky performances. It's a pleasure to hear it lengthened out and annealed, so to speak, in the Furtwängler furnace. But the musical world has found new things in Haydn since Furtwängler's formative years. Try Scherchen on Westminster, or Beecham on Columbia, if you want to know about them.

Debussy: Sonata for Flute, Viola and Harp; Syrinx (flute solo).
Roussel: Trio for Flute, Viola and Cello, op. 40. Julius Baker, fl., Lillian Fuchs, vla., Laura Newell, harp, Harry Fuchs, cello.

Here, in Decca's American recording, is one of the most sensitive performances of the difficult and subtle Debussy sonata I have yet heard, recorded to perfection in exactly the right poetic liveness. (Other recordings have been "hi-fi" to the point of destroying every trace of its atmosphere.) If the work has baffled you before—try it again here. You won't be disappointed. Similar treatment in the Roussel, a somewhat more contrapuntal (and less interesting) piece. Congrats to Decca.

The Joys and Sorrows of Spain.
Amor, Amor—Love Songs of Spain. Orquesta Zarzuela de Madrid, Torroba
(2 discs) **Decca DL 9798, 9788**
José Greco. Ballet. Orq. Zarz. de Madrid, Machado.
José Greco. Danzas Flamencas. Choreographic and Musical arrs. by Greco.
(2 discs) **DL 9757, 9758**

From Decca's Spanish pipeline comes this portion of the recent overwhelming flood of Spanish semi-light music on many labels. The indefatigable Senor Torroba leads his semi-pops orchestra, on the first two, in a tasty sort of Spanish Strauss pot-pourri, with a goodly dash of Kostelanetz—light, tuneful and heavily orchestrated stuff.

The Greco discs are evidently recorded stage performances. The ballet record has orchestral music, with occasional voices; the flamenco record features guitars and singers plus the inevitable excited bits of vocal encouragement, the "Oyés," in the background, sounding just a bit faked up here. The singers are excellent. Dancing feet audible, for extra rhythm and authenticity, if you like it.

Arriaga: Sinfonia a gran orquesta; "Los esclavos Felices", overture; Agar (cantata). Orq. Nat. de Madrid, Arambarri. Maria Ripolles, sopr.
Decca DL 9756

This budding Spanish composer died in Paris in 1826 before he was nineteen. He might have been a first-rate genius—who knows?

He was in the midst of his imitative period here, and the Grand Symphony is very intriguing in its charming reflection of the reigning influences of that day. Beethoven, straight-off (though Arriaga

graphic and Musical arrs. by Greco.
(2 discs) DL 9757, 9758

studied in Paris, not Vienna), then some fine Cherubini, flavored with Mendelssohn-like ornamentation. An excellent student work, very melodious, with only an occasional boyish bobble, an over-studious fugal imitation, to spoil the freshness.

The "Los Esclavos" overture is from his thirteenth year, before any formal study; the melodies again are sweet, the counterpoint remarkable for a boy, but the clumsinesses are pretty clear. He very much needed instruction and soon got it. The Cantata, say the notes, was written on French biblical lyrics; sounds like Italian to me and the piece is in the grand Italian aria style of the turn of the century, quite well imitated.

Not a trace of anything Spanish in the whole collection.

DESIGN PATENTS

(from page 36)

novelty and its production involved no exercise of the inventive faculties."

A Federal court in its decision of a controversy involving the alleged infringement of a design patent of an electric toaster, in holding that the patent had been infringed, summarized the essentials both of design and mechanical patents.

"In determining the validity of the claims involved, the following legal principles are applicable: first, that the issuance of a patent is enough to show, until the contrary appears, that all of the conditions prerequisite to patentability are present and that a heavy burden rests on the assailant to show invalidity.

"Second, that a new combination of elements, old in themselves but which produce a new and useful result or new diversity of arrangement of old things which introduce a new function or a new and useful method of performing the old function in a new way, support patentability.

"Third, if those skilled in the mechanical arts are working in a given field and after repeated efforts fail to discover a new and useful improvement, he who first makes the discovery has done more than the skilled mechanic in the art and has achieved patentability.

"We live in an age when the great masses of the population have little to spare for luxuries, which has created a demand for cheaply manufactured objects of both beauty and utility, and been a stimulant to designers. In order for one to be entitled to a design patent his creation must be the product of inventive skill and, as in mechanical patents, there must be originality and the exercise of inventive faculties.

"In the mechanical field there must be novelty and utility; in designs there must be originality and beauty. The combination of old forms to produce a new and ornamental design is not patentable unless the new design produces a new impression on the eye."

For seventy-five years a decision of the United States Supreme Court in an action involving a design patent of a saddle granted under the design patent law of 1842, has served as a yardstick in determining the presence of the essentials for valid patents.

clavier are ready to use. But best of all, you pay as you build—as little as
masses of the population have little to

In that case the lower court, in sustaining the design patent of this riding saddle, had said of its resemblance to other saddles.

"A mechanic may take the legs of a stove, and the cap of another, and the door of another, and make a new design which has no element of invention. But it does not follow that the result of the thought of a mechanic who has fused together two diverse shapes which were made upon different principles so that new lines and curves and a harmonious and novel whole are produced, which possesses a new grace and which has a utility resultant from the new shape, exhibits no invention."

Four years later this decision was reversed by the Supreme Court. In setting aside this judgment and holding the saddle design patent invalid that court laid down a rule that has since been an underlying principle governing the courts in their determination of the patentability of designs.

"The law applicable to design patents does not materially differ from that in cases of mechanical patents. To entitle a party to the benefit of the act in either case there must be originality and the exercise of the inventive faculty. In the one there must be novelty, in the other originality and beauty. Mere mechanical skill is insufficient. There must be something akin to genius—an effort of the brain as well as the hand. The adaptation of old devices or forms to new processes, however convenient, useful or beautiful they may be in their new role, is not invention.

"Many illustrations are referred to, as, for instance, the use of a model of the Centennial Building for paper weights and ink stands, the thrusting of a gas pipe through the leg and arm of a statue of a shepherd boy for the purpose of a drop light, the painting upon a familiar vase of a copy of Stuart's portrait of Washington—none of which were patentable because the elements of combination were old. The shape produced must be the result of industry, effort or genius and new and original as applied to articles of manufacture.

"The exercise of the inventive or originative faculty is required and a person cannot be permitted to select an existing form and simply put it to a new use any more than they can be permitted to take a patent for the mere double use of a machine. If however the selection and adoption of an existing form is more than the exercise of the imitative faculty and the result is a new effect and a new creation, the design may be patentable."

References

Application of Jennings, 182 Fed. 2d 207
In re Hopkins, 34 Fed. 2d 1016
In re Staunton, 35 Fed. 2d 63
In re Hopkins, 37 Fed. 2d 755
Heyer v. Allen Electric & Equipment Co., 37 F.S. 455
Forestek Plating & Mfg. Co. v. Knapp-Monarch Co., 106 Fed. 2d 554
Whitman Saddle Co. v. Smith, 148 U.S. 674, reversing 35 Fed. 414

"The exercise of the inventive or originative faculty is required and a

★ *Eliminates induced hum*

ABOUT MUSIC

You Can't Always Tell a Record by its Cover

HAROLD LAWRENCE*

Before the invention of the "album," dics were sold in drab yellow or faded green envelopes, and recording companies held to the obsolete conviction that their products could be merchandized in flimsy attire. Apart from the original investment in label art work and perhaps in drawings of their top artists for use on a standard stock envelope, the emphasis was on the record itself. Even after RCA Victor and Columbia began housing their symphonies and concertos in albums, covers were in keeping with their distinguished contents, e.g., RCA Victor's simple gold lettering over damasked floral patterns, with top billing for the composer.

Then during World War II *Art* entered the recording field. But what with war shortages and the Petrillo ban, it did not make much headway until nearly ten years later. A record-starved public in 1945–8 kept the record companies so busy filling back-orders that not much attention was paid to covers. Art's onward march was further delayed by the Columbia LP bombshell in 1948 when the first covers were modest and economically designed. On the advice of buyers from leading record shops, however, the recording companies began to veer in the direction of color, flesh, and fantasy. It is a proven fact that a bright and unusual cover will attract more attention in a window or on a display counter, and hence attract more sales. The race for the record-buyer's eye, now at fever pitch, has resulted in a special musico-advertising gallery of what at best contains some highly imaginative exhibits, and at worst—well, we'll get to those *later*.

First, a brief look at what happens when a cover artist fails to apprise himself of the contents of an album. On a new Mercury release of Bartók and Ravel Sonatas for Violin and Piano, neither instrument appears in the art work. Instead, there is a trombone, snare drum, bass drum, trumpet, string bass and piano. The bright colors and attitudes of the players suggest a jam session in progress. Now the second movement of the Ravel Sonata is entitled, *Blues*. But that's no excuse.

Another cover artist got his Greek names confused while working on Samuel Barber's *Medea*. He probably skipped a page while thumbing through his Mythological Dictionary and came up not with Medea, but *Medusa*, she of the terrible face and serpentine hairdo.

MGM's recent release of Alan Hovhannes's score for Clifford Odets's play, *The Flowering Peach*, bears a striking photograph on the cover. But no peach blossoms these . . . azaleas in full bloom!

On a visit to the United States a few years ago, the members of the Quartetto Italiano were informed that one of their

**26 W. 9th St., New York 11, N. Y.*

Capitol's Gleason record cover—a Dali painting. ". . . anguish, . . . space, . . . solitude."

6087 Sunset Boulevard
Hollywood 28, California

albums was being displayed in the window of a Madison Avenue record shop. To their surprise and amusement the drawing on the cover depicted four males. The second violinist, Elisa Pegreffi, happens to be a very charming young lady.

One of the finest Münchinger performances in the London catalogue is that of Mozart's Divertimento, K. 136, for strings—a trim, jolly chamber work. What do we have on the cover? To begin with, the scene is a large hall (or court). Instead of an intimate group, there is a symphony orchestra, part of which overflows into a corridor and up a flight of stairs on the right. To the left under arc lights a chorus, seemingly about to launch into the *Ode to Joy*.

So much for cover "boners." Three of the most popular ingredients in magazine art and photography are sex, children and pets. The first two have already found a secure place on covers of record albums. Sex, of course, came first. Scriabin's *Poem of Ecstasy* on RCA Victor features a sweet young thing clad in a diaphanous gown and reclining on a velvet cloud. Capitol's version of the same work pictures a nude lady in what seems to be a tropical setting. RCA Victor's *Relax with Victor Herbert* finds a languid model sitting in a living room and wearing a white negligee. A book is in her lap, yellow roses perfume the atmosphere, her eyes are closed. This is what Victor Herbert will do for you!

Liszt, Schumann, Tchaikovsky . . . what does it matter? There's always room for *l'amour*. Debussy composed two books of *Etudes*. As the titles indicate, this is purely abstract music, studies in octaves, thirds, repeated notes, arpeggios, chromatics, etc. For its new recording of these piano pieces, Epic provides a breathless close-up photograph of an enraptured model whose head is tossed back in utter abandon, and with roses in the foreground. RCA Victor's album of *Restful* (*Good*) *Music*, containing works by Cesti, Frescobaldi, and Bach, has a model reposing on a satin sofa wearing the uniform of the cover model: a diaphanous gown. The same apparel, or lack of it, is worn in *Music for a Summer Night*. There is also the ever-present rose in the right hand. For a change, the model is standing, not sitting, though the effort seems to have taxed her energies for the poor thing is leaning heavily against a Grecian column.

Now for the children. At first, they were kept in their place, restricted to such pieces as *Children's Corner* or *Kinderscenen*. Now the kiddies' invasion is in full swing. It all began rather quietly on the Entré label with the re-release of the Rodzinski version of Brahms's First. Between "Brahms" and "Symphony No. 1 in C Minor" was the photograph of a child falling asleep in her father's arms. This was followed on Columbia's album cover of the Shostakovitch Tenth by the picture of a little boy in a crowd. For a Roussel concert on Epic, there is a candid shot of a boy and girl musing. But with LC 3094, Epic really gets down to business. Enough of this dozing, musing and standing around—let's play! So our little boy and girl are off to a swimming pool. She creeps along the springboard, he fol-

is standing, not sitting, though the effort
seems to have taxed her energies for the
inch tape speed), smoothest tape movement, freedom from vibration,

lows. She turns and gazes at him. He looks off in the opposite direction, embarrassed but flattered. What else? Schumann's *Etudes Symphoniques,* of course!

At this point it is fairly obvious that the cover art need have no relation to the music it enfolds, like the paintings on paper back editions of the classics. RCA Victor, in fact, believes firmly in the doctrine of the separation of record and cover for their *His Master's Voice* albums. Most of these de luxe sets contain color reproductions of works by famous artists, suitable for framing. There are paintings by El Greco, Hals, and Van Dyck.

And speaking of the fine arts, the ultimate tribute to the selling power of the album cover is Capitol's latest Jackie Gleason recording. For this release, Capitol obtained the expensive talents of Salvador Dali who, it is reliably reported, will not turn out a painting the size of a postage stamp for less than $5,000. Here is Mr. Dali's "explanation" of his first album cover, the highest priced in recording history:

"The first effect is that of anguish, of space, and of *solitude.*

"Secondly, the fragility of the wings of a butterfly, projecting long shadows of late afternoon, reverberates in the landscape like an echo.

"The feminine element, distant and isolated, forms a perfect triangle with the musical instrument and its other echo, the shell."

Maybe you can't tell a *book* by its cover, but it's even tougher with records.

SOUND

(from page 34)

with the resonant frequency of the terrestrial mechanical system or of some part of it; the surface excursions reached their peak of violence, and a part of the surface was broken loose and hurled into space.

Another example of the effect of resonance on forced vibrations is the "wolf-note" produced in certain stringed instruments such as the cello. The body of the instrument, forced into vibration by the bowed string, has its own natural modes of oscillation, which help form the characteristic tone of the instrument. An unfortunate design may cause the excursions of belly and back to overvibrate at their primary resonant frequency. Pieces do not fly off, but the howling sound produced has the unpleasant connotations of its name.

Acoustical Resonant Sources

There are also sources of an acoustical nature in which free vibrations may be induced. These fall into two types; the air column, such as exists in the flute, pipe organ or "acoustical labyrinth" loudspeaker enclosure, and the Helmholtz resonator, illustrated by the empty bottle, the ocarina, or the bass-reflex speaker enclosure.

The simpler of these two is the Helmholtz resonator. It consists of an enclosed body of air with an opening or duct to the outside. If the longest acoustic path within the enclosed space is small relative to the wave-length of a stimulating oscillation, the internal pressure state at any instant will not vary significantly from one point to another, and the entire bulk of the imprisoned air will be compressed and rarefied as a unit.

The enclosed air supplies elasticity, and the requirements of a freely oscillating system (restoring force and inertia) are completed by the acoustic mass of the air in the port or duct. A close mechanical analogy would be a weight on a spring.

The Helmholtz resonator is characterized by the fact that it produces no harmonics, and that its natural frequency is determined by the dimensions of the port and the *volume* (not length) of the enclosure.

The resonant frequency of the air column, on the other hand, is determined precisely by the length of the column, and it is rich in harmonic overtones. The air can pulsate longitudinally as a whole, in sections, or in both modes simultaneously. It should be clear from the comparative characteristics of these two resonant devices that the air column is the one most suitable for musical instruments.

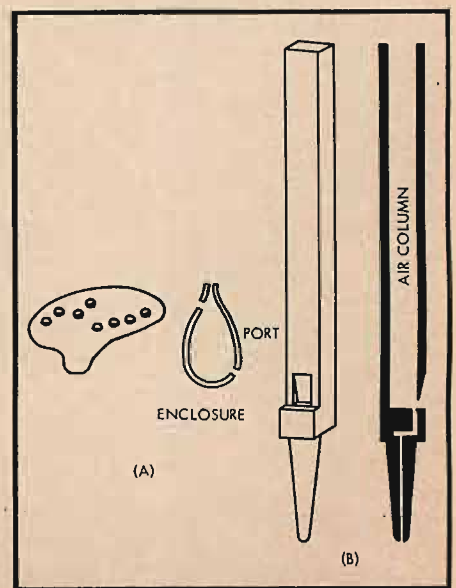

Fig. 1-6 Helmholtz and air column resonance, illustrated by simplified diagrams of ocarina and flue organ pipe.

Now you can consistently make professional
may be induced. These fall into two

HOW DO WE HEAR?

(*from page 21*)

over the membrane and hence the number of hair cells involved.

"The analysis of a compound wave follows the principles already laid down. However complex the form of the stapedial movement, a bulge always starts at the basal end of the cochlea and continues to be extended until there is a change in the direction of the stapedial movement. The number of bulges formed, therefore, corresponds to the number of maximum and minimum points in the compound wave; and the length of each bulge depends upon the amplitude as measured from one of these points to the next. Since the amplitudes between successive maximum and minimum points always vary in a compound wave, the different bulges will spread for different distances."

This description is clearly illustrated in *Fig.* 4 wherein is presented an initial displacement (position 1) of the first 30 units of the basilar membrane, as induced by the sound pressure amplitude at time *a*. The change in pressure as evidenced by the progress of the amplitude curve from time *a* to time *b* causes the formation of a bulge on the membrane which progresses a distance of 30 units of length, effectively erasing the initial bulge and resulting in a final membrane displacement to the right as shown in position 2. Further changes in the amplitude of the sound pressure wave as given at times *c* through *g* will cause corresponding displacements of the basilar membrane as shown in positions 3 through 7 respectively. The lengths of the membrane will be affected in accordance with the differential amplitudes of the sound pressure wave at the times of observation.

Meyer's theory is unique and his manner of presentation is abrupt, consequently it has not been too well received by the scientific world. This does not alter the fact, however, that it has merit which is recognized, for according to Wever, "Meyer's theory has had far less consideration than it deserves. It is a difficult theory; difficult in conception and perhaps more so in its presentation; and herein may lie part of the reason for its continued neglect."

Wrightson believed that the cochlear fluid was incompressible, consequently any movement of the stapes would set up a pressure wave which was instantly communicated to all parts of the cochlea. Since no time was lost in this transmission process, there could be no space effect, i.e., *all* nerve fibers were stimulated by sounds. Stimulation of the nerve fibers, occurring with every flexing of a hair cell, was said to occur four times for every full cycle of flexing motion of the basilar membrane; triggering of the nerve fibers occurs for every maximum, minimum, and axis-crossing point of the wave. Wrightson's thoughts on loudness of a sound were contained in his belief

which is recognized, for according to Wever, "Meyer's theory has had far less

Horn loading for bass reproduction

that the nerve fibers were affected more violently as sound intensity increased above near-threshold values. This belief has been subjected to a great deal of criticism in later days because of the "all-or-nothing" principle of nerve fiber firing which was developed.

Somewhere in this accumulation of knowledge an answer lies waiting to be born. From the laboratories and the experiments involving thresholds of hearing, pitch discrimination, spatial discrimination, cochlear microphonics, effects of various compounds upon the nerve electrical potentials, etc., will proceed one day the final link which will unite these findings into the truth sought over many long centuries. Until then, the reader may form opinions of his own, guided by the works of leading scientists partially summarized in the texts contained in the short bibliography below.

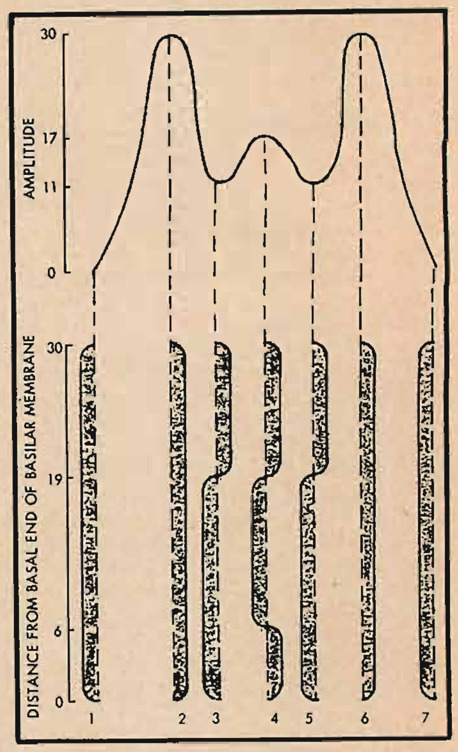

Fig. 4. Meyer's theory of cochlear analysis. The compound wave affects the basal portion of the basilar membrane as shown, at selected points of the wave cycle. Arbitrary scale units employed correspond to each other, in amplitude of distance.

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In one big volume, you can now learn all about the intricacies of commercial electronic organs, including the Allen, Baldwin

nerve electrical potentials, etc., will proceed one day the final link which will unite these findings into the truth sought

THE MINSHALL ORGAN

(*from page 27*)

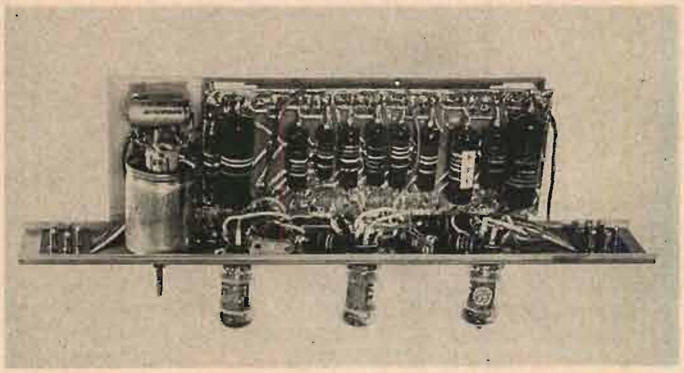

Fig. 8. Side view of a tone-generator chassis shows the printed circuit which holds most of the components.

ment brings grid impedances down to normal equipment values and this problem is eliminated.

Figure 8 shows how a tone-generator chassis looks. Notice that almost all the resistors and capacitors are mounted on a printed-circuit panel. The printed circuit makes for neat and inexpensive production and easy servicing since each component may be lifted or removed without disturbing others and may even be put back again without harm if found to be good. Minshall, at Mr. Hadden's instigation, has been among the first in the organ field to make extensive use of printed circuits and this organ probably contains more than any other in its tone generators and keying circuits, except for the Schol er Electronic Organ Kit which employs 130 all told. The generator chassis is extremely easy to replace when necessary because of good mechanical design. *Figure* 9 shows the rear of the organ. To remove a generator, the divider strap is loosened and the generator is simply pulled out; it is held in place only by the power and output plugs on its ends.

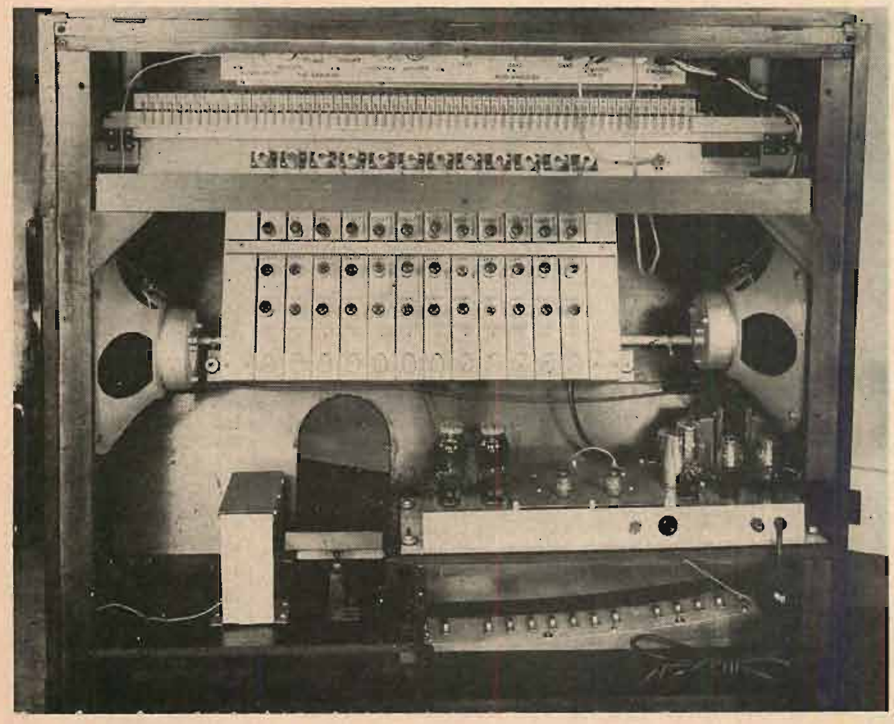

Fig. 9. Rear view of the Model L, showing the tone generators, power-supply and power amplifier, and tablet-board chassis.

Glinka—Kamarinskaja

AUDIO ETC.

(from page 47)

either; and so I had to drone on as best I could, in competition.

And another funny thing: the musical illustrations didn't go over, either. On the air, they were fine. No visible distractions and, as one listens to radio, the very *idea* of a musical illustration is highly acceptable. You sit back in your chair, or doze, or do the dishes (or drive the car—listening to your car radio) and time passes most agreeably. But on a lecture stage—no. My introduction would go over well enough in spite of distractions; but when the music started to play, something invariably happened. Simple enough!

The visual, live show all of a sudden stopped dead—except for one turning turntable, yet it was still *there* and had to be looked at. All of a sudden, I became mute. I froze. I had nothing to do, standing there in front of a whole audience, but look preoccupied, as though the music were piercing my very soul or something. (It wasn't, I can assure you.) And my assistant either froze, too, which made double-trouble, or she went to work on the next cue, which merely set up a welcome but irrelevant distraction.

Nope, it wouldn't go. And I even got complaints from some Ladies' Club managers that they thought I really shouldn't use a script—it looked bad. No use explaining that (a) a radio program *has* a script and (b) without a script I couldn't coordinate with my assistant, who followed me on her carbon copy. No avail!

The ladies were perfectly right; the idea really had basic faults. And so I gave it up, quite voluntarily, though I probably could be at it to this moment if I'd wanted to torture myself.

Now we have TV. And I commend this experience most earnestly to any AUDIO reader who has ideas of putting on a musical TV show. The conflict between listening habits and looking habits can be very acute, let me tell you. TV has already worked out its own look-listen techniques for a vast area of entertainment and instruction. But it still makes occasional well-intentioned boners when it comes to classical music and the dire necessity to combine the visual and the audible interest of music.

We *cannot,* however much we would like to, find a way to duplicate the "look-listen" of a live musical concert. Impossible. The best proof: your concert-goer sits for 1½ hours in a single seat with a single view, and is not disturbed by any lack of "variety." But on the screen—TV or film—with its two-dimensional projection, its narrow side-limits (even the "giant" screens), a single viewpoint is good for a mere thirty seconds or so at best. Then you must change. Flit here, flit there, close-up, distant-shot, follow-the-theme from instrument to instrument, watch the conductor's arms, his tortured face (he *must* be tortured or it won't look right)—occasionally pan out over the audience (and look out for people half-asleep in the front row where it shows). . . . This is what TV and the cinema require, for visual music. You can't dodge it any more than I could dodge the same sort of thing in my lectures. And so, live and learn, and back to tape and the all-audible show.

The Tape Solo

It wasn't long, after my home-grown show started, that I began to find things I could do with tape itself that were new. The sessions with my assistant grew shorter and my editing time longer. We did sections of the show in the old way, cross-fading records, blending background music and speech, and then I began to edit them together. We made mistakes, reeled the tape back and tried again until it worked. In no time I was splicing together dozens of short "takes," cutting out the plops and switching noises, the overlaps and repeats which we began more and more to take for granted as we caught onto tape. Isn't this exactly what every studio went through in those days? Yes, but not many home tape men.

And then came the day when I got tired of cross-fades and decided to try a straight splice between two musical passages, minus assistant.

I couldn't believe it would work. I was so indoctrinated with the idea of the cross-fade, a gradual *blending* of one piece of music with another, and I had done it so many thousands of times, that I was sure the instantaneous shift-over of a straight splice would "show" only too dismally, spoiling the nice effects of blending that I had been achieving. Little did I know.

For I soon found what every record maker knows, that, given the right spot, the right micro-instant, you can patch things together by splicing and never hear the transition at all. It works wonders for the tape editors who assemble recordings and broadcasts. It did even odder things for me, who deliberately spliced things the Lord never intended to be spliced, nor the composers!

Take two versions of a work, one for orchestra and the other for piano; compare them directly by joining hunks of each—so that a chord which starts as a piano sound is suddenly and inexplicably an orchestra sound, without apparent transition. Or patch up a flute and a violin version of a sonata (Prokofieff) so that the work breezes along merrily without a break—for both flute *and* violin, so that the flute player takes a big breath and comes out with fiddle sound, as naturally as you please, and the fiddler finds himself playing flute notes right in the middle of an up-bow. All very "strange to your ears," as another tape-trickster has put it.

Indeed, I got quite fascinated with the new possibilities and turned out phonomontage after phonomontage, each more devilish, instructive or silly (depending on how you listened) than the last. I compared three recordings of one piece, interchanging them dozens of times without a break in the music. I "rewrote" many a piece of music, altering continuity, making cuts and omitting repeats, all for special reasons and all without an audible break.

Caveat Emptor. One choral group I recorded didn't even notice a cut which, necessarily, made perfect gibberish out of the words being sung. People don't notice editing because—even today—they aren't prepared to notice it. And even an expert will miss the changeover if it is done properly.

Naturally, all of this musical mayhem was done with the best care I could possibly muster and I put every bit of musical knowledge I had into matching keys, melodies, harmony, structure and the rest. I'm proud of the tricks and except for a few emergencies, I'll stand by the "musicality" of my tape operations.

And so—the solo tape. I dispensed with

Magnet size and flux (Bl factor) can be meas- ured by applying a volt- like to, find a way to duplicate the look- Indeed, I got quite fascinated with the

my assistant entirely. I threw out my second turntable—no more cross-fading. I moved the portable fixings in a bit closer, mounted my mike on a goose-neck and got me a Hermes portable typewriter that would fit under *my nose*, and started out doing home-grown broadcasts, solo. The works.

It happened first, as I remember, in St. Louis in 1953 in the pantry of my elderly landlady-hostess's old-fashioned apartment. St. Louis had never seen anything like it —at least, the four or five St. Louis tradesmen who stumbled into the kitchen by the back door and interrupted me hadn't. From the pantry I moved into the maid's room on her day out. The trolley cars made less noise there. And each week, that spring of 1953, I set up the whole shebang, did my tape and then took it all down again and stored it in the closet. What a studio! But the show went on, back at WNYC.

Equalization

That is, it went on until I came back to New York in June just in time to catch the final broadcast which I'd mailed in the week before. I almost died of chagrin. For instead of my good hi-fi I heard an almost unbelievable bumble and rumble, an unintelligible hodge-podge—my voice sounded as though I were at the bottom of a well and buried in soggy mattresses. Why?

I had inadvertently made two mistakes which, I suspect, are still being made again and again by unsuspecting tape experimenters, even today.

A. Any broadcaster could have told me about this one, but I hadn't heard. To beat the background of St. Louis trolleys and busses I moved up unusually close to my cardioid mike. The ribbon complement thereupon proceeded to boom unmercifully. Never use a ribbon for close-to work! So, to begin with, my voice was horribly bass-heavy when it hit the tape. I didn't then know why.

B. My program was recorded on a Magnecorder (and is still today), a special job but still basically "Maggie," with the Magnecorder type of equalization. The tapes had been played on Magnecorders at WNYC, so all had been OK. But while I was away, WNYC bought some Ampexes and without a thought to the consequences blithely shifted my show over to one of them. Because of the differing methods of recording and playback equalization, my "Maggie" tapes came out of the Ampex with a ghastly droop in the highs and an apparently huge bass boost.

So—combine the already bass-heavy voice recording from the ribbon mike with the further bass-heavy reproduction due to mis-equalization in the playback and what came out was a sound more like a sick walrus than a well Canby. It was awful. I practically crawled under the bed for shame.

It took another year or so (during which we tried various bits of equalization at the station, with only partial success) before I hit upon a fine solution to the equalization problem. And, as for the voice, I went back, but quick, to my Altec condenser mike which, most handily, had an optional 40-cycle cut-off switch on it that neatly removed whatever boominess remained when I got up close.

I decided the thing to do was to have all my cakes and eat them too. I liked the Magnecorder for its easily managed editing, with the tape lying flat on the open head, the reels mounted vertically. For me, after long practice, it was good. So I got somebody to rebuild its electronics to give me two equalizations. Magnecorder and Ampex. Just flip a switch.

It took us some months to get things right, with test tapes flying down to WNYC for trial-and-error frequency runs, but in the end we came out so close to flat that I was thoroughly satisfied.

Now, for broadcast recording I can choose either type, Magnecorder or Ampex. I suspect that I own the only Magnecorder in existence that makes Ampex tapes—and Magnecorder tapes too.*

* The Magnecorder M—models now make tapes interchangeable with Ampex tapes.

One more discovery helped up the quality on my voice. The condenser mike made by Altec is technically non-directional, but *at close range*—within six inches or so—it picks up the voice much more naturally head-on, pointed at your mouth, than in the vertical position. When I accidentally discovered this, I was able to remove the last major difficulty that had bothered me, and since that time my tapes have been uniform enough to keep on file and repeat with reasonably good expectations for fine sound quality.

We do live and learn! I have on hand tapes back to my first experiments, but until three years ago I made so many unknowing technical blunders that many of them are now unusable. Two main headaches went along with me, over and above those already mentioned. The matter of exact speed (especially at the insides of the old-type 7-inch reels) and that of head alignment.

Alignment and Speed

I began aligning my heads before *every* broadcast (and how I hate the chore) in St. Louis, and I recommend the practice to every user of home-style tape. Most of my earlier shows proved to be recorded off-alignment in one way or another. Today, I must copy them, after aligning the playing head deliberately to match the individual tape, before I can use them.

Many an amateur, and some professionals, have forgotten that a wrongly aligned tape plays back beautifully *on the machine that made it*. A deadly trap for the unwary, I can assure you. I used to blame the people who cut disc transcriptions from my tapes for the soggy sound, but I don't any more. It was largely my fault. These are the weaknesses of any non-professional or semi-professional operation where standards are made up as you go along and things are worked out the hard way!

And as for speed, that, too, is a dangerous thing. As with alignment, a tape made on a machine that plays at the wrong speed, or that changes speed during recording, is very likely to play back perfectly on the same machine. The changes cancel out. But just try a bit of editing—or play the tape on a different machine, and see what happens to your pitch. Professional tape recording has now pretty much licked the pitch problem, even in Europe where, at first, trouble was rampant and music appeared on LP records in all sorts of wrong keys and with sags and speedings-up that were sometimes blood-curdling to a musical ear. No longer.

But in any non-professional set-up, again, the old trouble is likely to reappear—and you seldom discover it until too late.

My remedies were severally simple, over some length of time.

A. Periodic cleaning and overhaul of the tape machine, even though it seems to be in fine condition. Makes all the difference.

B. The use of a stroboscope, every so often, to check exact running speed under operating conditions. Most tape recorder firms will provide one for you.

C. Most important—the new reels with wide hubs. Users of 10-inch professional-type reels need not worry. But if you still have some of the small-hub 7-inch reels around, stay clear of the last half-inch of

recording from the ribbon mike with the further bass-heavy reproduction due to mis-
machine. The changes cancel out. But just try a bit of editing—or play the tape on
sary to perform all the good high fidelity func-

tape, on any machine! I used such a reel, without noticing, on my Ampex 600 the other day. Sure enough, as the end of the tape approached, the music (from the playback head) began to flutter and squeal. The machine just isn't designed for the old reels. Fortunately, there are very few of them left nowadays. The large-hub 7-inch reel was a major innovation (along with the thinner tape that made it possible), improving speed accuracy by a huge factor in a couple of million existing tape recorders. I hate to think of the number of man-hours I wasted thanks to the old reels, before I found out about them.

* * * *

Enough. This rambling account has goaded a good many readers, I suspect, into fury at me for omitting the spicy details, (good and bad) of the Canby Home-Grown Tape Technique. For the edification of amateurs and, even, a few professionals, I'll go on in a future issue to present details, for what they're worth in entertainment and education. Home-style or no, I think some of the tricks of the trade are worth describing. It's a great game.

COMING EVENTS

Sept. 23–24—Fifth Annual Fall Symposium of the I.R.E. Professional Group on Broadcast Transmission Systems, Hamilton Hotel, Washington, D. C.

Sept. 23–25—Hi-Fi Home Music Show, Claremont Hotel, Berkeley, Calif.

Sept. 30–Oct. 2—Third Annual High Fidelity Audio Show, NCAS, Sheraton-Palace Hotel, San Francisco, Calif.

Sept. 30–Oct. 2—The 1955 High Fidelity Show, Palmer House, Chicago.

Oct. 3–5—National Electronics Conference, Hotel Sherman, Chicago.

Oct. 13–16—The Audio Fair and the Seventh Annual Convention of the Audio Engineering Society. Hotel New Yorker, New York City.

Oct. 21–23—New England High Fidelity and Music Show, Hotel Touraine, Boston, Mass.

Nov. 4–6—Philadelphia High Fidelity Show, Benjamin Franklin Hotel, Philadelphia, Pa. A fifty-cent admission charge has been agreed upon to assure attendance by an interested hi-fi conscious audience.

Nov. 3–6—First Mexican Audio Fair, Hotel Reforma, Mexico City. For information, write Mario R. Aguilar, Lopez 43-301, Mexico 1, D. F.

Jan. 18–20—Canadian Audio Show, Windsor Hotel, Montreal, Canada. Managing Director, Emery Justus, 1022 Sherbrooke St. W. Montreal, P. Q.

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BRAND NEW Meissner Model 4DR disc recorder with 60 discs and Ampro tape recorder. Value over $350. Will sell for $165.

Industry Notes . . .

The Bell & Howell Company, long known as a leading manufacturer of motion picture equipment, made an auspicious entry into the high fidelity field with a press showing on August 25.

On hand to introduce the impressive new B&H radio-phonos were Frank Bennett, Vice President in Charge of Engineering, who designed the electronic portion of the new units, and Howard Cushing who is in charge of high-fidelity sales. Visitors were deeply impressed with both the sound and appearance of the various models on display. The showing took place in the Manhattan penthouse studios of Paul McCobb, noted furniture designer, who was commissioned to design the cabinetry of the new B&H hi-fi radio-phonos. Hostess for the occasion was charming Betty Lyman, Assistant Director of the Bell & Howell public relations department, who flew from Chicago for the event.

Mercury Record Corporation has announced its entry into the phonograph and tape recorder field, and early in September began shipping a complete line of portable and hi-fi phonographs and tape recorders to distributors throughout the country. According to Irving B. Green, company president, the move is an important step in Mercury's previously announced program of expansion and diversification. In an earlier move, the company launched a wholly-owned subsidiary record label, Wing Records.

The Washington, D. C., district offices of **Ampex Corporation** have been moved to a new address at 8033 13th St., Silver Spring, Md. In announcing the move, George I. Long, Ampex president explained that larger quarters were necessitated by expansion of district office activities and the addition of new staff members. The Washington district office provides facilities for sales engineering and service engineering personnel from both Ampex product divisions, Audio and Instrumentation.

British Industries Corporation, New York, has broadened the scope of the high-fidelity products for which it acts as national sales agents with the addition of River Edge equipment cabinets and speaker enclosures. In announcing the entry of River Edge products into the BIC fold, Leonard Carduner, head of BIC, stated that the new operation will be handled by a company formed for the specific purpose, **River Edge Sales Corporation.** Henry Sherwin of **River Edge Industries** joined with Mr. Carduner in announcing the new affiliation. Sales policies will prevail which govern all other BIC products, such as Garrard Record Changers, Wharfdale Speakers, R-J Enclosures and Leak amplifiers.

The Pentron Corporation has entered the field of pre-recorded tapes with its first recording of "Moods in Music," a 15-minute dual-track tape featuring Larry Paige and His orchestra. Recording speed is 7.5 ips. Because the Pentron tapes are made solely for playing on tape reproducers, musical arrangers are given widest latitude in realizing the full potential of tape as a recording medium. Both extreme highs and lows, as well as extremes in dynamic range, play important parts in the arrangements. According to Irving Rossman, Pentron president, the tapes will perform equally well on any make of tape reproducer. Recording was done with professional Dynacord recording equipment.

The Pentron Corporation has entered the field of pre-recorded tapes with its
pects — Outdoor Loudspeaker Output-Power Requirements — Specifications —

ADVERTISING INDEX

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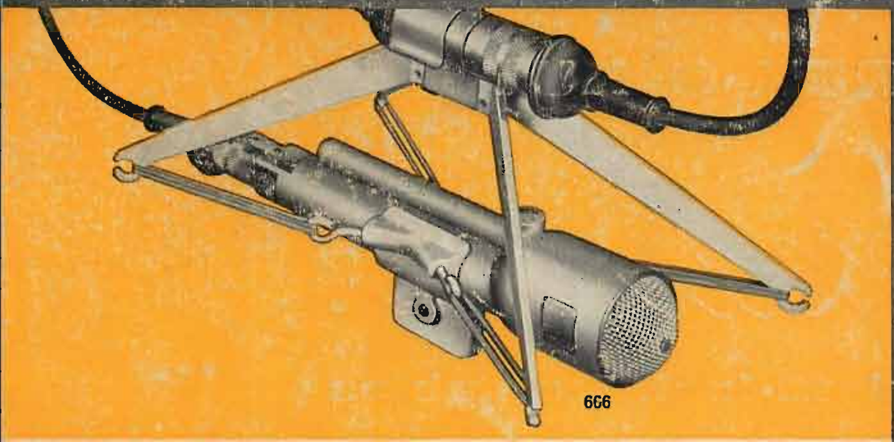

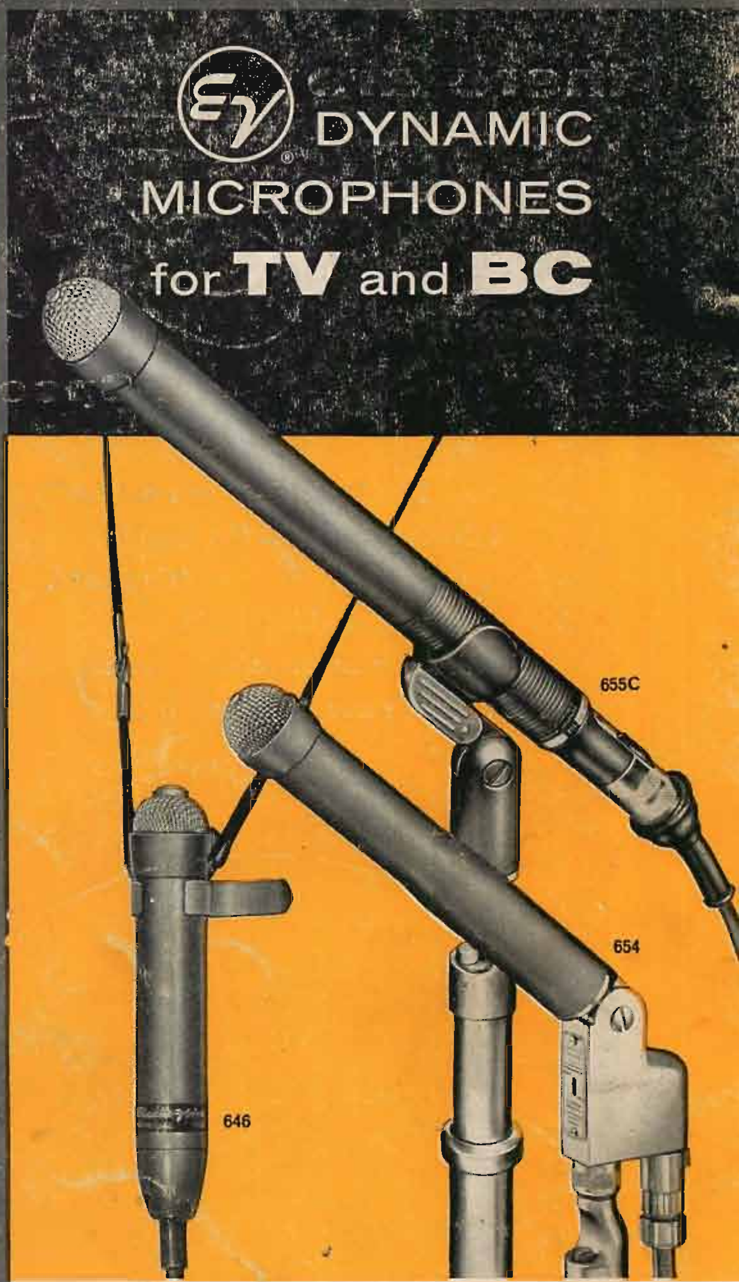

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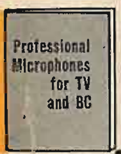

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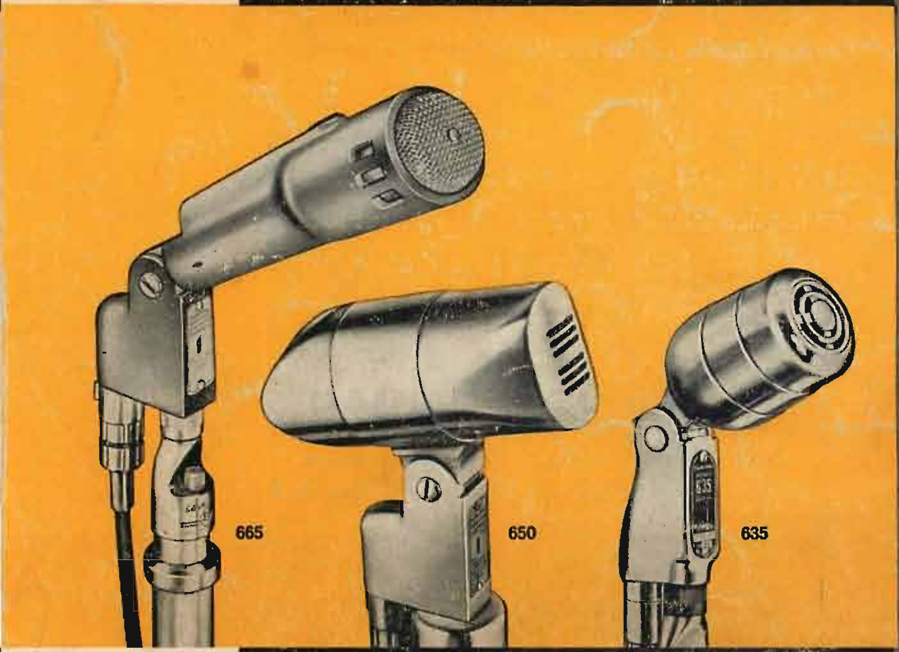

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Model 646. Lavalier-type. Response 40 to 10,000 cps. Adjustable for chest use. Output level -55 db. Omnidirectional. TV gray. 1-in. diam. Weighs only 7 oz. **List Price..........$140.**

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Model 650. Response 40 to 15,000 cps. Output level -48 db. Omnidirectional. Dual-type external shock mount. Impedance selector. TV gray or satin chrome. **List Price..........$150.**

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