How to Brace a Speaker Cabinet - See Page 24

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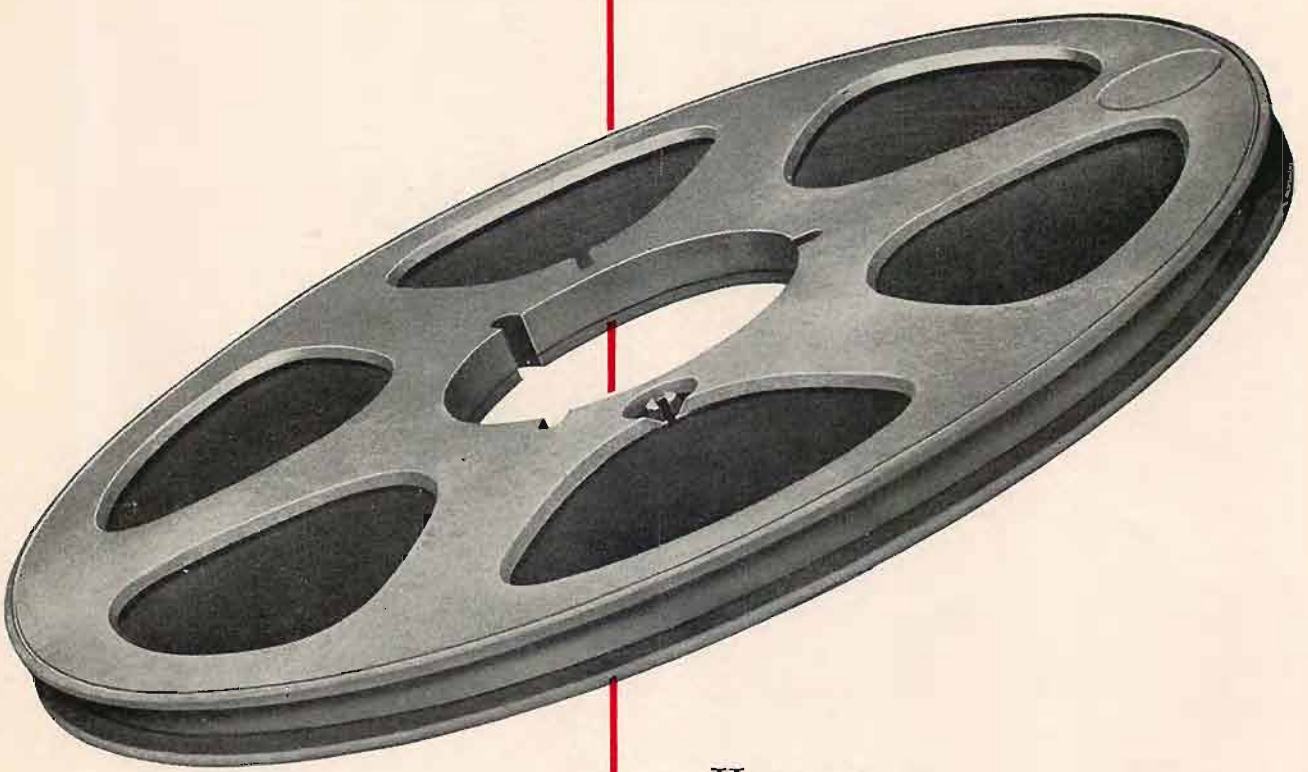

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CONTENTS — DECEMBER, 1953 — Vol. 37, No. 12

COVER

Most Christmas trees throughout the nation will feature toys and dolls this month —the former for little boys and the latter for little girls. However, lives there an audio hobbyist with soul so dead who never to himself has admitted inclinations toward both—"toys" in the form of amplifiers, speakers, tape recorders, and other paraphernalia dear to the heart of those who search for good music reproduction, and "dolls" such as model Marta Roman. This photo, conceived three years ago, awaited realization until the right doll could be located. Studio and equipment were supplied by Air Tone Sound & Recording Company, of Philadelphia.

RADIO MAGAZINES, INC., P. O. BOX 629, MINEOLA, N. Y.

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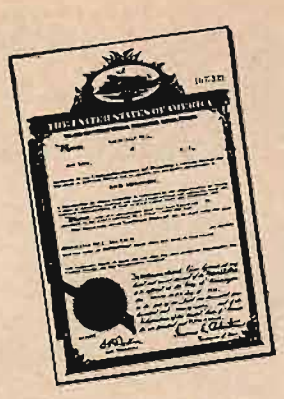


AUDIO PATENTS

RICHARD H. DORF*

TODAY'S BEST AUDIO AMPLIFIERS are becoming better and better; in fact, it is quite possible that they are—from the performance standpoint—as good as they ever need to be. Distortion is down to negligible values which cannot affect our ears; frequency curves are flat as a pancake; and output powers are more than enough. This may sound a little like the statements that were said to be made sometime in the late eighties that all the inventions that could be made were already made.

That is not the sense of the remark. A good many more inventions and developments need to be made in the audio field—not to improve the possible quality of amplifiers, but to improve the normal individual's chances of obtaining an amplifier with optimum characteristics for something less than an arm and a leg. In other words, now that we know we *can* have amplifiers with fidelity better than the original music,[1] let's simplify and cheapen the circuits and components so that everybody can have one.

One of the paradoxical reasons for high cost in amplifiers is that the band to be transmitted must usually be very much wider than the band anyone can hear. A few amplifiers are flat up to the apparently ridiculous frequency of 100,000 cps. and more where even a bat would need a hearing aid. But this is required to provide for the large percentage of negative feedback, which is primarily responsible for high audio quality. If there is attenuation of the pass band anywhere near the ends of the audible spectrum, there will also be phase shift which spells death by oscillation to the feedback loops because of reversing phase at certain points.

It seems to the writer that John M. Miller has struck out along the right path in his patent No. 2,652,458, which is assigned to Bendix. The patent covers an "amplifier with positive and negative feedback," but there is as much horse sense as engineering in the approach, and more than immediately meets the eye.

The advantages of negative feedback are well known—reduction of distortion of all kinds, including frequency, and loudspeaker damping. In the last couple of years the advantages of adding positive current feedback within the amplifier have come into the open; with it some of the offset in gain caused by negative voltage feedback can be reduced and the output impedance can be brought right down to zero, or even negative values, for almost perfect speaker damping. The rub is that the usual method of applying optimally large amounts of positive and negative feedback requires highly expensive output transformers and wideband coupling in all the stages.

Mr. Miller's amplifier has both negative and positive feedback loops. His trick is principally (a) to recognize that with a transformer of good but not premium quality, the negative feedback will, after the extremes of the audible band, turn positive: and (b) to simply incorporate a very elementary network in the positive feedback loop so that when the negative feedback tends to become positive and the positive feedback tends to become negative and keeps the amplifier form oscillating.

Figure 1 shows the schematic diagram of an amplifier designed according to the invention. The amplifier proper (which be-

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

[1] Joke. No indignant letters, please!

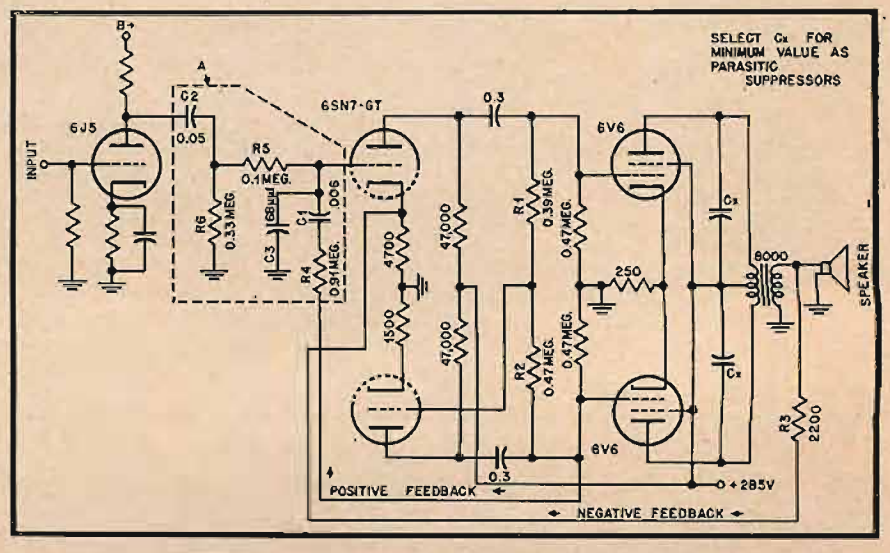


Fig. 1.

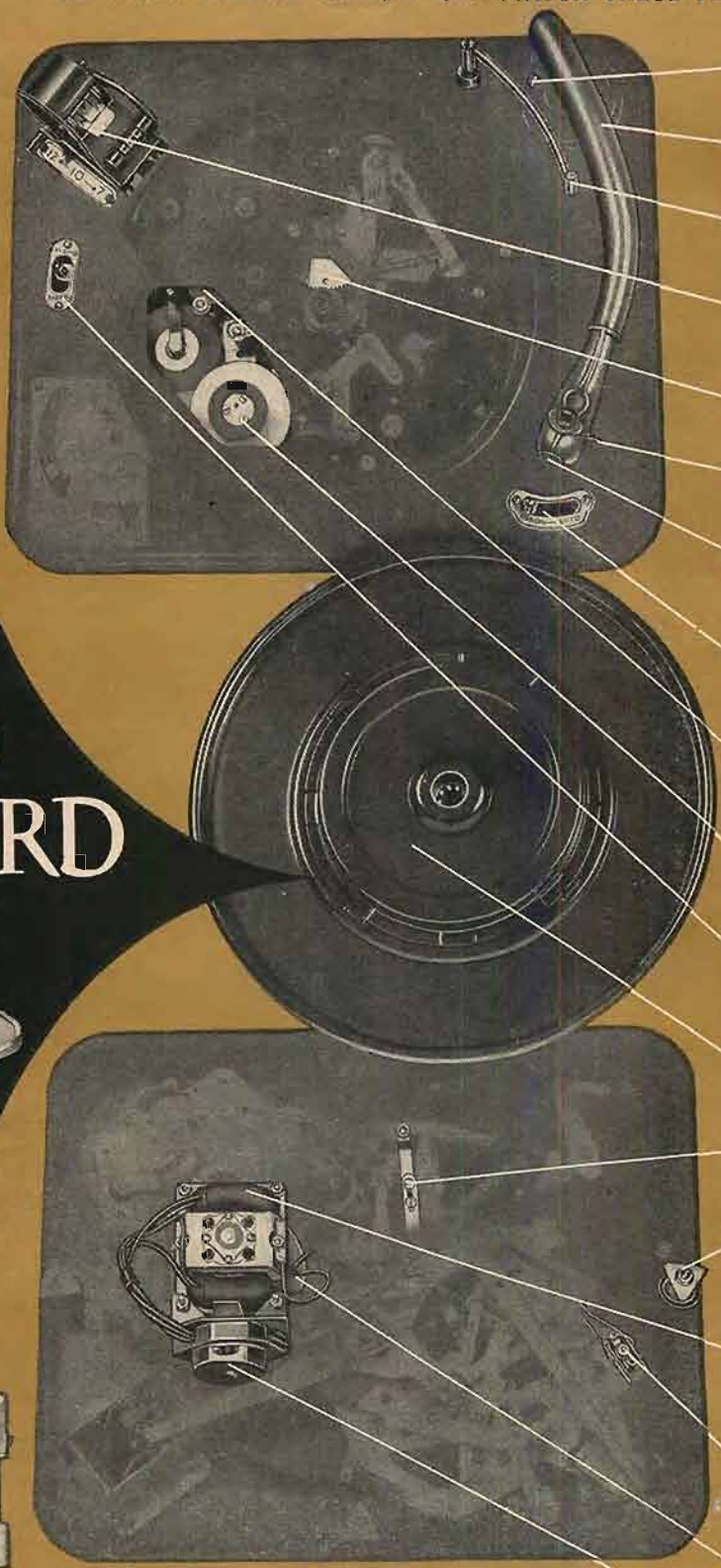
NO OTHER RECORD CHANGER CAN MATCH THESE FEATURES

Here's what they mean to you

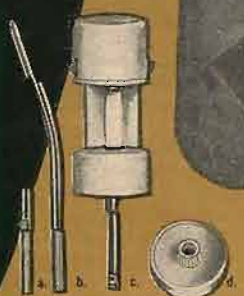
Why the "CROWN" MODEL RC90 GARRARD

is the

World's Finest Record Changer



ACCESSIBLE STYLUS PRESSURE ADJUSTMENT	Prolongs life of records by enabling you to keep correct weight of stylus upon delicate grooves.
BALANCE-MOUNTED TONE ARM	Guarantees true tangent tracking, eliminating disturbing resonances.
AUTOMATIC STOP	For your convenience, insures positive and unfailing action at end of any type record.
GENTLE, PRECISION PUSHER PLATFORM	The only device that insures gentle handling of records with standard center holes. No overhead bridge to damage or dislodge records accidentally.
PRECISION GROUND GEARS	Perfectly meshed to insure constant, smooth action and years of service.
PROFESSIONAL-TYPE FINGER LIFT	Permits safe lifting and setting down of pick-up arm when playing records manually.
INTERCHANGEABLE PLUG-IN HEADS WITH STYLUS VISIBLE	Accommodates your personal choice of magnetic, ceramic or crystal cartridges, and protects record grooves, since stylus can be front-inspected for correct vertical position.
MANUAL POSITION SWITCH	Gives you versatility...manual or automatic playing, as you prefer.
FAST CHANGING CYCLE	The same, regardless of playing speeds; means less waiting between long playing records.
NO WOWS! STEPPED PULLEY DRIVE . . . WITH INTERMEDIATE BALANCED DRIVE WHEEL	Cannot slip. Eliminates belts and guarantees smooth, even turntable speed, which you will enjoy as perfect musical pitch.
FAST-SLOW SPEED ADJUSTMENT	All 3 speeds variable and adjustable. Guarantees perfect pitch; accurate speed settings. Compensates for current imperfections.
WEIGHTED, BALANCED TURNTABLE	Means freedom from rumble, and constant turning speed through "flywheel" action.
WATCH-LIKE CONSTRUCTION	All levers fully adjustable . . . easy, inexpensive to service. Bronze bearings at all moving points for longer life!
SHOCKPROOF INSTALLATION	Unique spring suspension. Mounting holes are identical with former Garrard models, so that replacement is simple.
RUMBLE-FREE! ADVANCED HEAVY DUTY 4-POLE MOTOR	Makes your RC90 the smoothest, most powerful, most silent record changer ever built! Weighted, balanced armature. No appreciable speed variation regardless of number of records on turntable; "hot" or "cold" operation, or variations in line voltage.
MUTING SWITCH	Continuity of your music undisturbed by extraneous noises between records. No sound while arm is in changing cycle.
MAGNETIC EDDY CURRENT SPEED CONTROL	A great high-fidelity achievement! Speed controlled by varying the field of a pair of permanent magnets...eliminating old-fashioned mechanical or electrical braking.
CONDENSOR-RESISTOR NETWORK	Eliminates startling "plop" noise when changer shuts off at end of last record.



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gins at the output of the conventional 6J5 voltage amplifier) includes the 6SN7-GT phase splitter and a 6V6 output stage. According to the tube manual the output rating can be conservatively set at a little over 10 watts, with home music system high-quality standards in mind. The 6J5 plate signal, after passing through a network A (of which more later) is fed to the "self-balancing" phase splitter. The grid of the lower 6SN7 triode obtains its signal from voltage divider R_7–R_8 across the push-pull splitter output. The output stage is conventional, the value of the cathode resistor having been supplied by the writer. All other values are given by the inventor.

The negative feedback loop is a standard type, from the secondary of the output transformer to the first cathode of the phase splitter. R_8 and the tube's cathode impedance form a voltage divider which determines the negative feedback factor.

The positive feedback loop is an internal one, from the grid of the lower output tube back to the first phase-splitter grid. The positive feedback is fixed, for mid-range frequencies, by the voltage divider R_1–R_4 (and, of course, to some extent by the admittance of the 6SN7 triode and the plate resistance of the 6J5 in parallel with R_4 and R_7). It is adjusted to a point where there exists a condition of critical regeneration in the amplifier with the negative feedback loop disconnected. When the negative loop is connected the over-all gain is reduced well below the point of amplifier instability. However, the high positive feedback has created an amplifier of high gain without incurring the penalty of steep boundary-frequency phase shifts which would come with the employment of several stages, and, of course, at a cheaper price. The critical regeneration can easily be maintained over the entire range of useful—that is, audible—frequencies.

The low inherent phase shift of the amplifier permits the use of a low priced output transformer even though it is in the negative feedback loop. The over-all gain is primarily an inverse function of the feedback factor of the negative loop. Ordinary feedback theory shows that under this circumstance harmonic distortion and intermodulation are negligible up to any signal level at which there is sufficient overloading to disable one of the feedback loops.

Oscillation Prevention

So far, the scheme is apparently not new, at least in theory. But the theory has always been very difficult to realize practically because at frequencies outside the useful range the sense of the negative feedback changes and it becomes positive, causing oscillation. There are some common solutions. One is to design all the coupling elements in the amplifier so that frequency slope is no greater than 10 db per octave within the range for which negative-feedback loop gain is unity or greater. That costs money, especially where the output transformer is concerned. Another method is to introduce compensatory networks in the negative loop to apply reverse phase shifts. That is expensive, too, and risky.

The inventor's solution is to leave the negative loop alone and deal with the positive feedback loop. Change in positive feedback phase is not a danger, of course, since it could only tend to reduce amplifier gain and reduce chance of oscillation. In the diagram the job is done by the nework A.

At mid-range frequencies, we have said that loop transmission is controlled by R_1 and R_2. At low audio frequencies transmission depends on the ratio of capacitors

jumps are for Horses

...**NOT** *for magnetic tape*

That's why you need SOUNDCRAFT Micro-Polished Tape.*
No Raised Spots! No Roughness! No Jumps!
It's Smooth right from the start!

Under the microscope, magnetic tape may look like a steeplechase—replete with all the "jumps." As you record, these jumps—minute raised spots characteristic of all coating processes—momentarily separate large enough areas of the tape from the recording head to appreciably interrupt high-frequency response. On some equipment, they may even cause signal dropouts.

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Breaking in tape by running it through the recorder, with accompanying head wear and waste of time, is a thing of the past.

Other SOUNDCRAFT Advantages

In addition, SOUNDCRAFT Recording Tapes are pre-coated with a special formulation to give utmost oxide adhesion, and prevent curling and cupping.

All tape is dry-lubricated to eliminate squeals and carries a splice-free guarantee on all 1200- and 2500-foot reels.

REEVES

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*Pat. Applied For.

C_1 and C_2 which then have appreciable reactance. They are designed to have about the same capacitance ratio as the resistance ratio of R_4 and R_5.

At the very low frequencies (where the negative feedback begins to shift phase and become dangerous) the reactance of C_1 becomes high with respect to the resistance of R_6. C_1–R_6 then becomes a phase-shift and high-pass-filter network, reducing the positive feedback in the very low audio and the subaudio ranges and shifting its phase so that as frequency gets lower the feedback becomes negative. This offsets the tendency in the low range of the negative feedback in the other loop to become positive due to the natural deficiencies of such circuits and the reasonable-quality transformer. The positive feedback begins to reverse at frequencies only slightly lower than the lowest desired useful frequency so that even if the transformer has rather sharp cutoff characteristics at this point the gain of the amplifier is reduced sufficiently to prevent oscillation. Increase of distortion due to loss of feedback does not matter—nobody can hear it.

At high frequencies, capacitor C_3 (and the input capacitance of the 6SN7) acts with R_1 as a phase-shift and low-pass-filter network. Just slightly above the audible range the positive feedback is reduced and starts to become negative, reducing amplifier gain so that the cutoff of the transformer just above audibility cannot cause oscillation due to phase shift in the negative feedback loop.

It is obvious, therefore, that extension of the range of the amplifier and the transformer to the usual ultrasonic range is not necessary with this circuit. At some frequencies well above and below audibility, phase conditions in the feedback loops may make them both positive, but at these frequencies the loop gains have been made deliberately too small to permit oscillation.

Thus we have an amplifier which is cheap because (a) it can give sufficient gain with only two stages and (b) the output transformer can be standard—no $30-plus quality and no tertiary or split windings. Yet it can (or so it seems) give all the quality which the art makes possible today. The writer would like to hear from anyone who tries the circuit.

There is not much more detail in the patent specification but you can get a copy for 25¢ from The Commissioner of Patents, Washington 25, D. C.

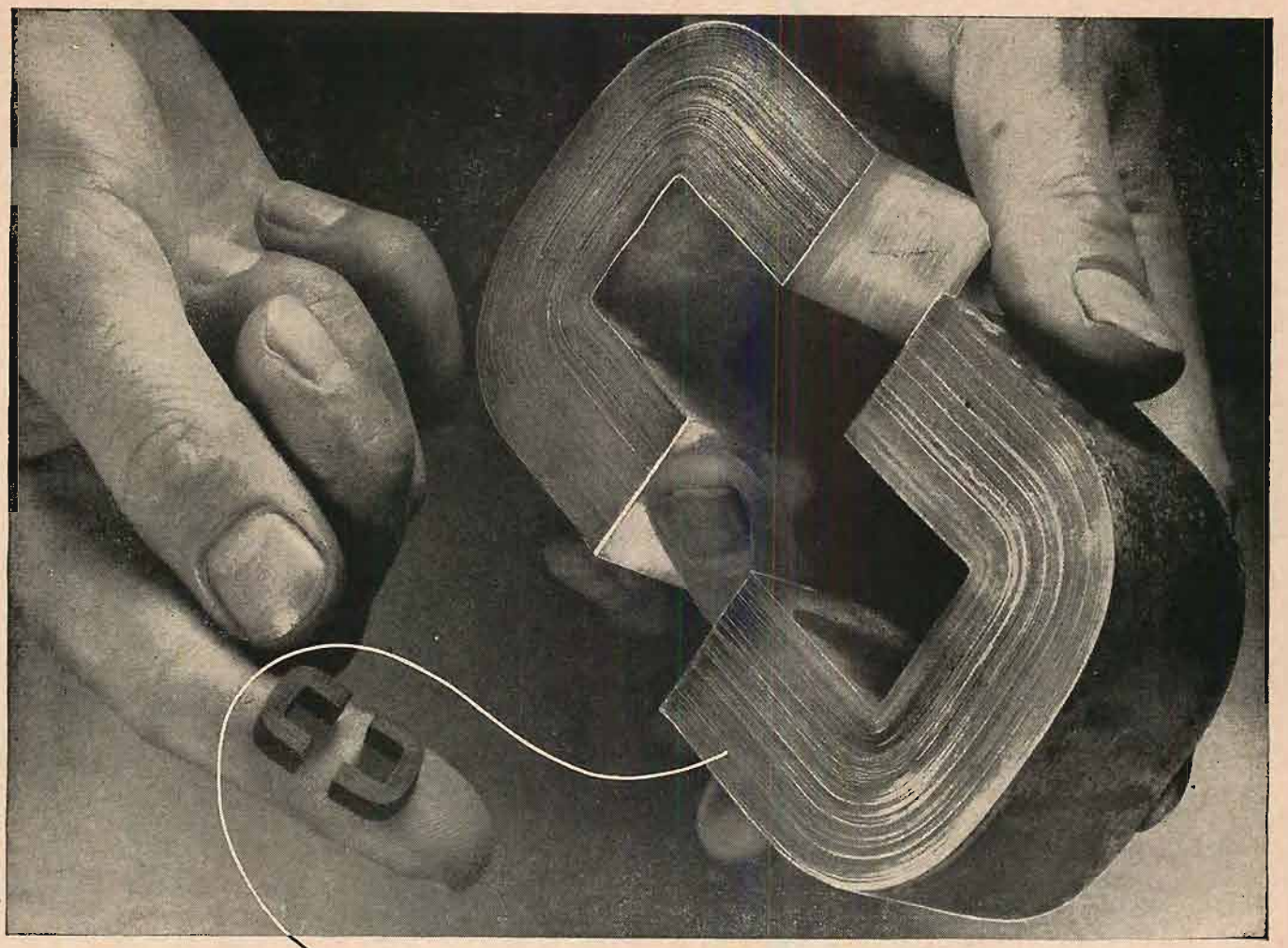
BOOK REVIEW

CIRCUIT THEORY OF ELECTRON DEVICES, by E. Milton Boon. 483 pages, $8.50. New York: John Wiley and Sons, Inc., 1953.

This is a book primarily intended for electrical engineering students. It analyzes basic circuit operation, deriving expressions relating to gain, source impedance, the effect of feedback, etc. The use of equivalent circuits, and the mathematical derivations are presented especially clearly, both in concept and in format. (The latter is never forbidding.) The treatment of an amplifier as a four-terminal network makes the analysis a general one, applicable to all electron devices. Both tube and transistor circuit theory are discussed.

The clarity of the presentation recommends this book to general technical readers as well as to students.

—EMV



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We can offer prompt delivery in production quantities—*and size is no object, from a fraction of an ounce to C-Cores of 200 pounds or more.* Rigid standard tests—and special electrical tests where required—give you assurance of the highest quality in all gauges. • *Your inquiries are invited.*

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LETTERS

Comments on "The Piano"

SIR:

It is good to see in Æ such interesting and instructive articles as the two of Mr. Preisman's on "The Piano." Unfortunately the music trades magazines seldom carry articles of technical scope and merit on the science of musical tone production, and you are to be commended on these because we—your readers—are all interested in musical tone production as well as reproduction.

Especially since 1930, when my own research activities were transferred from reproduction to production of musical tones, expecially through electronics, I have been much concerned with piano-tone production. Except for some sixty patents in this field, I have published very little on the results of these researches, but Mr. Preisman's articles leave a few interesting gaps which can be filled in.

For example, it does not appear to be generally known that the bridge and the soundboard respond to modulations of string tension, and since these are bicyclic, except at very high vibration amplitude, there is a strong frequency-doubling action. This occurs for all of the orbital rotational planes of the string vibration, and can be easily demonstrated with a small desk-type postal scale and a yard length of cord. Stretch the cord between fixed supports over the scale pan with the scale near one end and with an angle or "bearing" of, say, 30 deg. between this "string" and the "hitch pin" close by. If now the string's long section by displaced up, down, and to either side, the scale will in each case indicate a larger pressure and deflection. Since the scale pan, representing a piano bridge and soundboard, moves downward for a downward deflection of the string, and again downward for an upward or sideward deflection, there are two complete cycles of bridge motion for one cycle of string motion.

Force-displacement measurements of the bridge and soundboard show considerable non-linearity and this accounts for the appearance of a fundamental vibration component of the string in the soundboard motion.

The frequency characteristic of the soundboard varies from bass to treble along the bridge from about 90 cps to about 500 cps and these values change in different pianos. Poor fundamental response of a 30- to 60-cps string through a 90- to 100-cps soundboard is therefore to be expected. Likewise, in the treble end, a 3000- to 4000-cps string fundamental is beset by a 400- to 500-cps soundboard.

The high and low registers therefore suffer from poorly matched impedances and only the middle register—particularly the low middle range—has proper impedance matching, and it is here where the output tone is at its best.

The orientation of a grand piano soundboard is, of course, extremely bad. Acting as its own baffle, both top and bottom sides are about in the plane of a listener's ears, so there is strong cancellation of the low-frequency components of the lower tone registers. Upright pianos are much better in this respect, but the low-frequency performance of both types can be much improved by absorption of the radiation of one side or, as in some commercial loudspeaker enclosures, by reversing the phase of the radiation of one side through a folded horn, for example.

The better tone resulting from multiple unison strings is due not to the increased sound output so much as to the chorus effects among slightly detuned overtones. If these unisons are tuned to one beat in three seconds, for example—a value which is about as good on the average as a tuner can do—the higher numbered partials will have higher beating rates so that the 10th, say, will be ten times as fast or three per second. The vibration planes and orbits of the three unisons will also have random and changing phases so that the soundboard motion and output tones undergo a continuous change in quality as the tone decays.

Another element of piano-tone quality, as Baldwin's Knoblough has pointed out, is due to longitudinal vibration of the string. This varies according to the piano string scale design. In my six-foot Steinway "A" it is generally about four octaves above the fundamental frequency and only by rare chance is it harmonically related. We hear this as the ringing tone of the lower register strings. It has a full Fourier series of partials, all but the fundamental being well up into the high-frequency end of the audio spectrum.

The piano-tone production system is really very complex and much still remains to be learned. My few remarks cover only a small part of this generally unknown area. Piano designing and building is hardly an exact science, insofar as tone production is concerned, and this is a challenging field of research.

B. F. MIESSNER,
Van Beuren Road, RFD 2,
Morristown, N. J.

SIR:

Mr. Preisman's discussion of the practice of mistuning the octaves at the extreme ends of a piano in accordance with the "inharmonicity" of its overtones was read with great interest. In my opinion, this practice is ill-advised. Its theoretical usage seems to be dictated by the Pythagorean comma, a disparity existing between the pitch of octave unisons produced by a circle of perfect fifths, and those resulting from harmonics. However, the beats between the octaves of a piano "stretched" in this fashion are much more annoying to me than the "dead and lifeless" sound of a piano in which the octaves are precisely in tune. I am sure that a piano with octaves tuned to the interval of a diminished ninth would sound quite brilliant, but not necessarily pleasant. After all, equal temperament is in itself a radical distortion of natural harmonic relationships, so why compound the felony by further tampering? There is a possible parallel here between people who prefer "Stretched" pianos and people who like their reproducing equipment to sound spectacular rather than natural.

Aside from these small matters, I have found Mr. Preisman's articles valuable and informative especially with their emphasis of the musical element which all too often tends to lose itself in this business. Incidentally, the Conn tuning device is called a *Strobocon*, and someone seems to have recatalogued Chopin's Etude Op. 25 as Op. 75 in the footnote on page 68.

DAVID HANCOCK,
4 West 93rd St.,
New York 25, N. Y.

Missing Decimals

SIR:

The article titled "Three-Element Bass Control" in the October issue appeared to be the best one I have ever seen. It is too bad that I can't build this control. You left off the decimal points and I can't tell if one resistor or another is required. For example, what is 01 or 047 or 005? Just where is the decimal point? And why does such a little thing get me so riled up I make all sorts of errors in typing this letter to you? (*He did, too.* ED.)

H. A. ROLLINS,
2328 Proctor,
Garland, Texas.

(*We're truly sorry for this condition, which has been reported by many readers. It appears that the photoengraving for the schematic was overetched, and the periods were all eaten off. However, because the circuit was of so much interest to readers, we remade the cut and a more legible schematic may be found on page 70.* ED.)

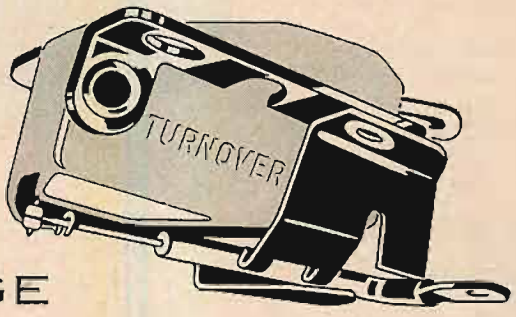
SIMPLICITY FIDELITY

Fidelity and Simplicity are synonymous in the

TITONE

TURNOVER

CERAMIC CARTRIDGE



Only through the magic of the Titone ceramic principle —an original development of the Sonotone Laboratories —may record reproduction have the advantage of both Fidelity and Simplicity.

Now your finest records may be flawlessly reproduced without equalizers, preamplifiers, oscillators, polarizing voltages—or any of the other cumbersome, erratic and costly accessories heretofore deemed necessary.

NO PREAMPLIFIER

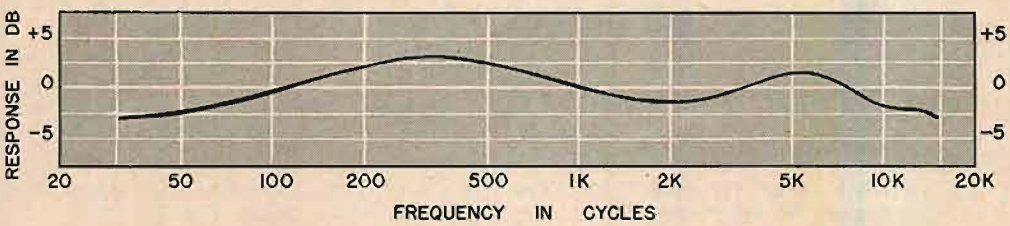
This tiny new Titone reproducer utilizes barium titanate in a high compliance design to provide one volt output on modern microgroove records. For example, average measured output at 1000 cycles on the RCA 12-5-51V test record is 0.95 volt.

NO EQUALIZERS

The typical frequency response—with no equalization —is flat within ± 3 db from 30 to 15,000 cycles on the new RCA 12-5-51V test record. Similar flat outputs are obtained from records cut to LP, NAB, AES, and other modern characteristics.

NO SPECIAL COMPONENTS

The high output voltage and the ceramic structure provide the highest signal-to-hum ratio available, eliminating the need for special motors, turntables or mu-metal shields.



TITONE TURNOVER RESPONSE ON RCA 12-5-51V RECORD

TITONE TURNOVER

List Prices

9980-S	(Dual-sapphire)	$9.50
9980-SD	(.001 Diamond) (.003 Sapphire)	34.00
9980-D	(Dual Diamond)	56.00

Electronic Applications Division

SONOTONE CORPORATION

Elmsford, New York

tervals ranging from one to many weeks depending upon the power output, circuit design, and extent of use.

A modern hearing-aid tube suitable for front-end amplifier use has a filament power requirement of only 10 milliwatts; with usage of 15 hours daily, this can be provided for almost a month by a tiny "A" cell costing only 75 cents, or ten dollars per year. Even so, total battery costs may run fifty dollars or more per year with instruments using tubes throughout.

Transistors

Battery costs may be materially reduced through use of a transistor in the output stage, and further power economy is possible if transistors are used throughout. But replacement of tubes by transistors is more than a simple substitution, particularly if widely variable tone control is to be provided. Full use of transistor potentialities in hearing aids is contingent upon the development of suitably reliable related components at reasonable cost, as well as improvement in the transistors themselves. Novelty value alone can be expected to become ever less, but power economy and miniaturization are permanent issues in which transistors have inherent advantage.

Transistors have been at some disadvantage from standpoint of circuit noise, and with present costs of subminiature capacitors or transformers suitable for tone control and for interstage coupling of low impedance circuits. Thus manufacturers tend to have active interest both in transistors and in improved subminiature tubes. One instrument maker fulfills opposing requirements with a transistor in the output stage and tubes in two earlier stages. But as a useful tool in hearing aid design, the transistor is undoubtedly already here to stay, and has changed the whole outlook on instrument planning.

COMING EVENTS

February 4–6—Audio Fair—Los Angeles, Alexandria Hotel, Los Angeles, Calif.

March 22–25—National convention of The Institute of Radio Engineers, Kingsbridge Armory and Waldorf-Astoria Hotel, New York City.

May 17–20—Electronic Parts Show, Conrad Hilton Hotel, Chicago, Ill.

May 23–29—NARTB Annual Convention, Palmer House, Chicago, Ill.

June 15-17—RETMA Annual Convention, Palmer House, Chicago, Ill.

September 30–October 3—High Fidelity Show, Palmer House, Chicago.

October 13–16—The Audio Fair, Hotel New Yorker, New York City.

Compare

Collaro

FULLY AUTOMATIC

3-SPEED RECORD CHANGERS

for 7, 10 and 12 inch Records

WITH ANY RECORD CHANGERS IN THE FIELD REGARDLESS OF PRICE

for RUMBLE FLUTTER and WOW

These are the tests of high fidelity . . . not claims, not boasts. That's why Collaro, confident of the results, invites you to compare.

Collaro has developed an entirely new turntable drive mechanism, and thus has succeeded in achieving performance considered impossible in earlier record changer designs. Rumble, wow, and flutter are virtually eliminated. Mechanical operation is smooth . . . gentle to the record and to the delicate stylus.

And while you are comparing these, look at the construction. Note that there are no intermediate drive wheels employed and no belts to slip or to replace. Rotate the turntable and observe how freely it spins. This is the combined result of dynamic balance and ball-bearing suspension. Now lift the turntable. It's heavy . . . intentionally weighted to give flywheel action for constant, steady rotation. You'll notice that the turntable is rubber covered. Important...because unlike other materials in use this surface does not shed; and dust and grit particles cannot become imbedded. On the underside is a 4-pole motor with self-aligning oilite bearings for silent steady power.

You will also discover that the Collaro changers are absolutely jam-proof; that they automatically shut off at the end of the last record; that the tone arm is ball-bearing mounted, and tracks accurately with as little as 3 gram stylus pressure.

Remember these features . . . look for them, compare them . . . and you will agree that Collaro really makes *high fidelity record changers for high fidelity record reproduction.*

	LIST PRICE
Model 3/532 intermixes 10 and 12 inch records	$65.00
Model 3/531 Non-intermix	54.50
Model 3/534 Single record player	33.60

Available at Radio Parts Jobbers, Distributors, and Hi-Fi Dealers.

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EDITOR'S REPORT

WIDER COVERAGE

MORE AND MORE people are becoming interested in high-quality sound reproduction in the home—a fact which must be apparent to any of Æ's readers who also see other magazines and newspapers. Some months ago, *Life* acknowledged the existence of the hi-fi fad with an article which seemed to explore the ultra-fanatic type of hobbyist to the exclusion of the serious music listener who has found in hi-fi the solution to his desire for music as it should be heard. Most of the big home magazines are taking notice at least once a year of the existence of equipment which would provide better sound, and they have dressed up their presentations in a manner which would be expected from the "slicks." They are to be congratulated for their interest and the manner in which they present the material.

We are inclined to "view with alarm" the tendency exhibited by the *New York Times* which recently carried a 14-page hi-fi section in a Sunday edition. In this section appeared the advertising of manufacturers and distributors of audio equipment, with which we have no quarrel, but in the same section there also appeared two articles which ridiculed the hi-fi hobbyist and the entire hi-fi idea as a whole. How *The Times* can take advertising for a certain type of product and then ridicule the users of that product is beyond our comprehension.

Be that as it may, we are acutely aware that the newcomers to the hi-fi field are not all hobbyists in the sense that they build some of their equipment and are constantly experimenting with it in the search for perfection. Most of the newcomers just want good equipment which will give them good reproduction, and they want it with a minimum of bother and effort. Then there are others who want information on how to assemble the factory-built components into a workmanlike and attractive combination which give them the desired results.

For some time Æ has been widening its coverage in that direction, yet without reducing the technical articles which the audio hobbyists have come to expect. In the February issue, therefore, you may expect to find still more material for the non-technical music lover, and with that issue a new department—as such—will be inaugurated. Just a word of caution—don't be confused by the facelifting job on the Feburary issue, for a change is coming. After all, we haven't changed the appearance of the magazine appreciably since March, 1949. (We planned the change for the January issue, but time goes too fast and we didn't make it.)

AUDIO FAIR—LOS ANGELES

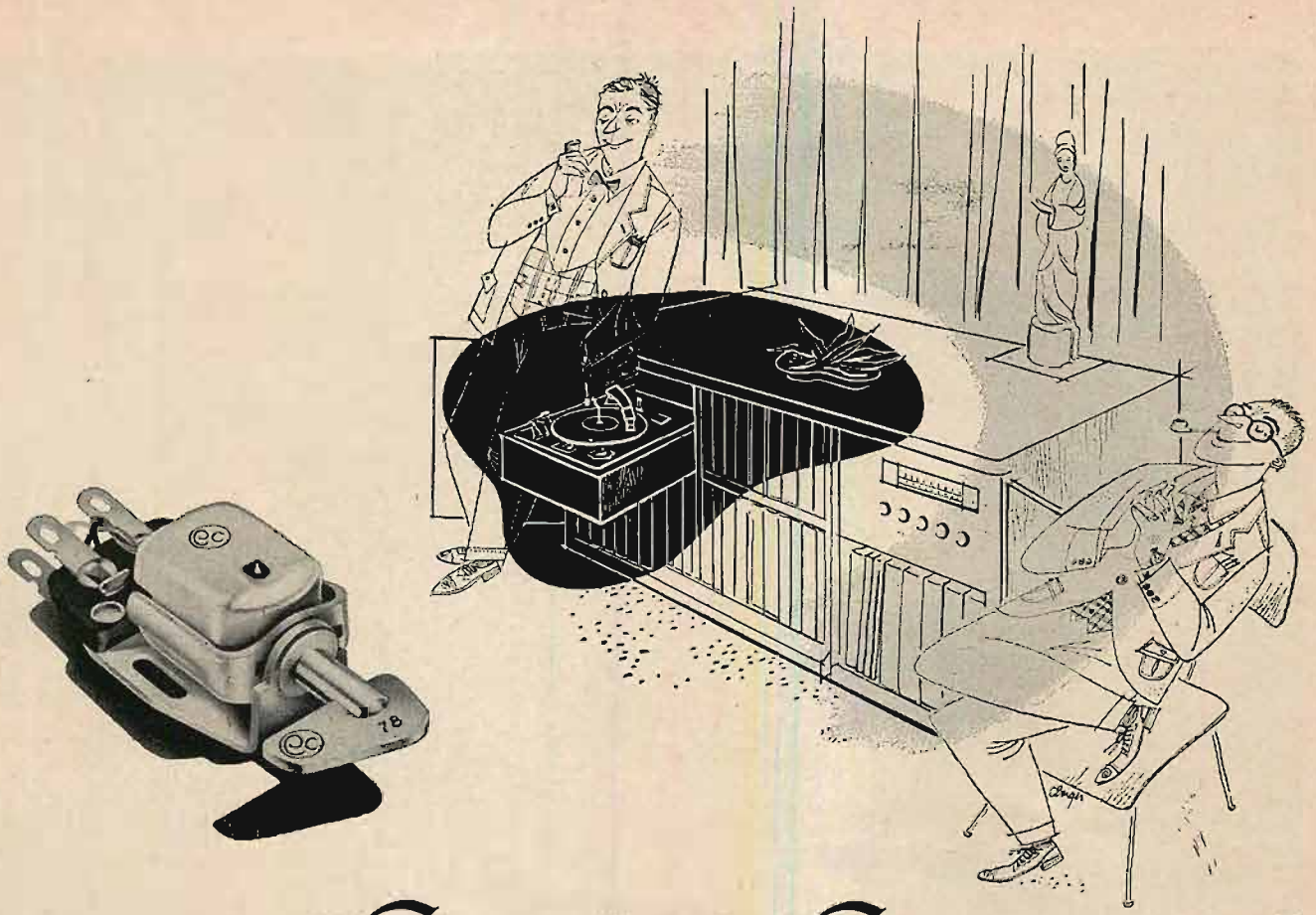
Heralded as the "Audio Fiesta—A Festival of Sound," the second Audio Fair—Los Angeles opens on February 4 at the Alexandria Hotel in the City of the Angels. This is the big audio event of the year on the West Coast, and we wonder how big the attendance will be. Last year, the figure was around 17,000, and was topped only by the recent Audio Fair in New York, which racked up an attendance of over 25,000. This may be the new East–West contest of the year. In any case, don't fail to be there if it is at all possible. If you've never seen an Audio Fair, you've missed something; if you ever have attended one, the chances are that you'll be there again.

APOLOGY

Everyone makes a mistake occasionally, and we're no better than the average, it seems. One of the photos used in the article "It Can be Attractive" was wrongly credited. Naturally when an organization does a good job on putting in a music system, it likes to receive credit for it—and particularly does it not want credit given to someone who had nothing whatever to do with the work. At the top of page 31 in the November issue is shown an attractive installation which was actually made by Shrader Manufacturing Company, Inc., of Washington, D. C., and we take this opportunity of apologizing to Bill Shrader—who has often contributed to Æ's pages, and who will be back again soon—and to give the credit where it is due.

Merry Christmas & Happy New Year

from all of us to all of you



"I'm glad I waited..."

Here's how I solved a problem that bothered me . . . and may be bothering you.

Many of my favorite recordings happen to be 78's. They mean as much to me as any of my newer LP's or 45's. Changing pickups was often a real nuisance—and yet I wasn't willing to give up the superior quality of my two Pickering cartridges.

Last fall my dealer offered a suggestion. "Wait a little longer," he said. "You'll be glad you did."

He was right. I now have Pickering's new turn-over cartridge. A simple flip of the handy lever and I'm ready to play any favorite that fits my mood—whether it's standard or microgroove. *More than that,* I'd swear my recordings sound better than ever.

I'm glad I waited . . . but you won't have to.

Ask your dealer to show you this convenient new turn-over cartridge. Have him demonstrate it. See if you, too, don't hear the difference!

PICKERING ***and company incorporated • Oceanside, L. I., New York***

PICKERING PROFESSIONAL AUDIO COMPONENTS

"For those who can hear the difference"

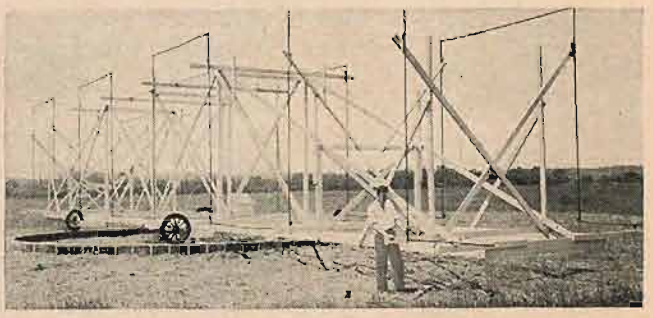
...Demonstrated and sold by Leading Radio Parts Distributors everywhere.
For the one nearest you and for detailed literature, write Dept. A-3

How silent is the night?

Watching the serenity of Christmas skies, we are conscious of deep silence. Yet the stars are talking to us all the while—talking in radio waves that are full of meaning to scientists probing the depths of space.

The important discovery that some stars produce radio waves was made by a Bell Laboratories scientist while exploring atmospheric disturbances which might interfere with transoceanic telephone service.

His discovery marked the birth of the fast-growing science of radio astronomy. It is telling us of mysterious lightless stars that broadcast radio waves, and it promises new and exciting revelations about the vast regions of space concealed by clouds of cosmic dust.



Directional radio antenna used by Karl G. Jansky, in the discovery of stellar radio signals at the Holmdel, New Jersey, branch of Bell Telephone Laboratories. In 1932 he detected waves of 14.6 meters coming from the direction of Sagittarius in the Milky Way.

It is another example of how Bell Telephone Laboratories scientists make broad and important discoveries as they seek ways to make your telephone serve you better.

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EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE.

Magnetic Transfer of Stainless Steel Recording Wire

SAMUEL STORCHHEIM*

Wire recording is still employed in many useful applications, and the effects of signal transfer between adjacent turns may become troublesome. The author reports the results of a number of tests made to determine the optimum working conditions for various recording wires.

One of the phenomena accompanying magnetic wire recording is that of magnetic transfer. This condition involves the magnetization of unrecorded turns of wire by adjacent turns of recorded wire, the wire usually being made of 18/8 stainless steel. Transfer is popularly referred to as "crosstalk" and is particularly noted when quietly recorded passages of wire follow or precede heavily recorded portions of wire. An illustration of what this sounds like would be the hearing of two radio stations on the same setting, one station coming in normally, the other annoyingly clear, though at a lower volume than the desired program.

In order to investigate transfer, a study was made of the effect magnetic properties such as remanence, B_r, and coersive force, H_c, had upon transfer when wires were magnetized with increasing recording currents.

Procedure

The magnetic parameters of remanence and coersive force were measured directly from hysteresis loops projected upon a previously calibrated cathode-ray oscilloscope screen. The hysteresis loop tester used to make these measurements was specially designed[1] and constructed, and was capable of accepting wires of a maximum of ⅛ in. diameter. The accuracy obtained using this unit was ±2.5 per cent for the H_c values and ±5 per cent for the B_r values. Several strands, generally six, of fine wire, .004 in. or .0036 in., had to be tested in order to obtain accurate B_r readings. The larger the area of wire used, the more lines of flux were available for measurement, i.e., the hysteresis loops were longer and B_r measurements were more readily made. The value of coersive force was dependent upon the applied field. Once the field was established, the H_c remained constant regardless of how many strands of wire were used.

The testing procedure followed was to take a spool of 7500 ft. of fine diam. wire and record a 1000-cps signal from an audio oscillator through a 4.5-to-1 step down transformer upon the first 100 ft. The signal was placed on the wire using a Shure recording and playback head and a 50-kc bias at 75 ma. The recording currents used for this purpose ranged from 0.47 to 85.0 milliamperes. Once the 100-ft length of wire was magnetized it was rewound upon its unrecorded balance. After this was done, the wire was played back through the Shure head and an amplifying and filter system so the output of the recorded and unrecorded parts could be measured. These determinations were made in db using a Ballentine voltmeter with an arbitrarily chosen zero point. It was found that the output of the wires directly recorded upon ranged from +30 to +32 db at a noise level of −26 db, while the output of transfer signals ranged from a high of +16 db to a low of −25.5 db. (The negative values exist because of the arbitrarily chosen zero point on the indicating voltmeter.)

The transfer of the wires was observed to occur immediately after the original signal on the recorded portion of wire dropped off as indicated by the voltmeter. Transfer was shown to be not a uniformly recorded signal along the length of wire but rather a series of "bursts" of magnetized portions along the wire. It was noted that the transfer signal gradually diminished in output as the distance between the recorded and unrecorded portions of wire increased. A very effective visual demonstration of the actual transfer phenomena was observed by placing a cathode ray oscilloscope in the system. Transfer could then be seen as a succession of "flashing" sine waves corresponding to the original signal but of lesser amplitude. These flashes decreased in amplitude with increased distance between the recorded and unrecorded passages of wire until eventually no trace of transfer could be observed.

Results

The data obtained during these studies are tabulated in Table 1. Curves plotted from these data, *Figs.* 1 to 6, indicate the following:

Figure 1, plots of transfer *vs.* recording current for .004-in. diameter wires of various H_c and B_r values, show that transfer first increases to a maximum value, levels off and then declines as the recording current is increased. There appears to be a trend as to the effect the actual values of H_c and B_r have on the maximum transfer value of the curve and where this maximum value lies along the recording current abscissa. *Figure* 2 is a plot of maximum transfer value for a particular wire versus the remanence of the wire. The curve shows that as the remanence increases the maximum transfer value also increases.

Figure 3 shows the curve obtained when the recording current for maximum transfer value for a specimen is graphed *vs.* the coersive force of the specimen. The trend is for increasing recording current with increasing coersive force; i.e., the peak of the curves in *Fig.* 1 move to the right as the coersive force increases. This means a lower rate of increase in transfer at the lower recording currents, which would be of practical advantage. Thus, *Figs.* 2 and 3

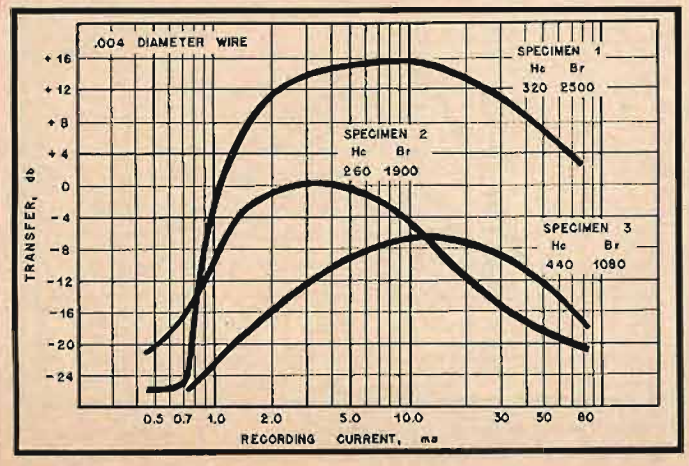


Fig. 1. Transfer vs. recording current for three specimens of .004-in. wire.

*Engineer-in-Charge, Atomic Energy Division, Sylvania Electric Products Corp., Bayside, L. I., N. Y.

[1] W. W. Wetzel, "Review of the present status of magnetic recording theory, Part I," Audio Engineering, Nov. 1947.

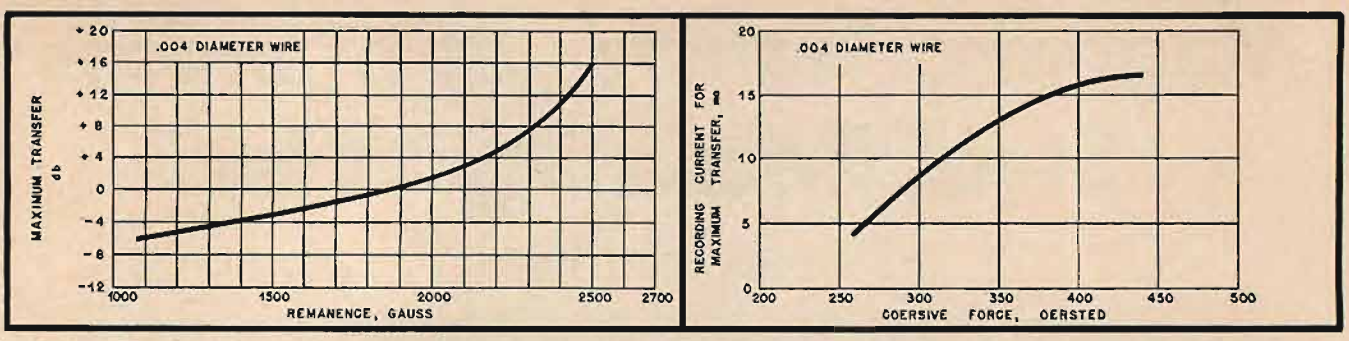


Fig. 2 (left). Transfer vs. remanence for one of the specimens of Fig.1. Fig. 3 (right). Recording current for maximum transfer vs. coersive force in oersteds, for one specimen of .004-in. wire.

indicate that transfer can be minimized by decreasing the remanence and increasing the coersive force. Lowering the remanence in turn lowers the output of a recording wire and there is, therefore, a limit to how low a value of B_r can be tolerated. Too high an increase in coersive force, which increases the difficulty of erasure of a recorded wire is, therefore, also limited.

Figure 4 is a plot similar to that of *Fig.* 1 The specimens used in this case were .004-in. diameter wires obtained from another source. Here it is seen that the same general trends occur; i.e., the curves rise, level off and then decline. The maximum transfer values also show up as increasing as the remanences increase. The effect of coersive force is not as clear as in *Figs.* 1 and 3; however, both H_c values are rather close and the indication is that the currents for maximum transfer for both curves are about the same.

Figure 5 represents the transfer values *vs.* recording current for finer wire, namely, .0036 in. rather than .004 in. Again the curves repeat the now familiar pattern of rise, level, and decline. Also, the higher remanence values cause higher maximum transfer values. The higher coersive force also moves the peak transfer value toward higher recording currents. In addition, as with .004-in. wire, the higher coercive force seems to cause the slope of the rising part of the curve to be less steep.

Finally, *Fig.* 6 shows a comparison between the effect the diameter of the wires involved has upon the curves of transfer *vs.* recording current. Here it is seen that the general appearances of the two curves are similar, however, the peak value for transfer for the .004-in. wire is higher than that of the .0036-in. wire, both wires having almost the same B_r values. As with the curves representing .004-in. wire, the higher value of the H_c appeared to move the peak of the curve representing .004-in. wire to higher recording currents. Interestingly, the slope of the lower H_c curve, .0036-in. wire, was steeper than that of the higher H_c curve. This seems to be a reversal of what was found regarding the effect of H_c on .004-in. and .0036-in. wire when compared to other .004-in. and .0036-in. wire, respectively.

Thus, a smaller diameter wire would appear to minimize transfer and so a finer wire is more desirable. There is a limit to this however, for as the diameter of the wire in fine sizes is decreased, wire drawing costs rise very rapidly. Another limiting factor is that the wire in finer sizes would snap if the recording unit started or stopped too suddenly: i.e., the wire although having a greater tensile strength as measured in pounds per square inch in the finer sizes would actually allow only for a lesser breaking load as measured in pounds.

Discussion

A possible explanation of why the magnetic transfer phenomenon behaves as it does has been considered and is as follows:

Magnetic transfer is simply the physical or very near physical contact of a magnetized permanent magnet, a turn of wire, inducing a contacted non-magnetized permanent magnet to a partial

(*Continued on page 56*)

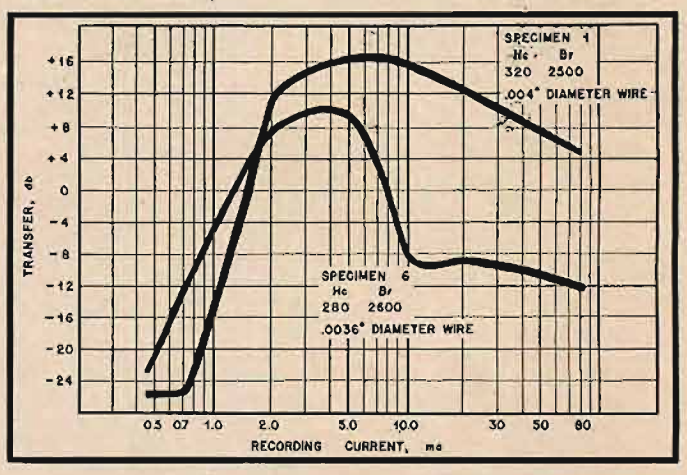


Fig. 6. Comparison of transfer vs. recording current for two wires of different diameters.

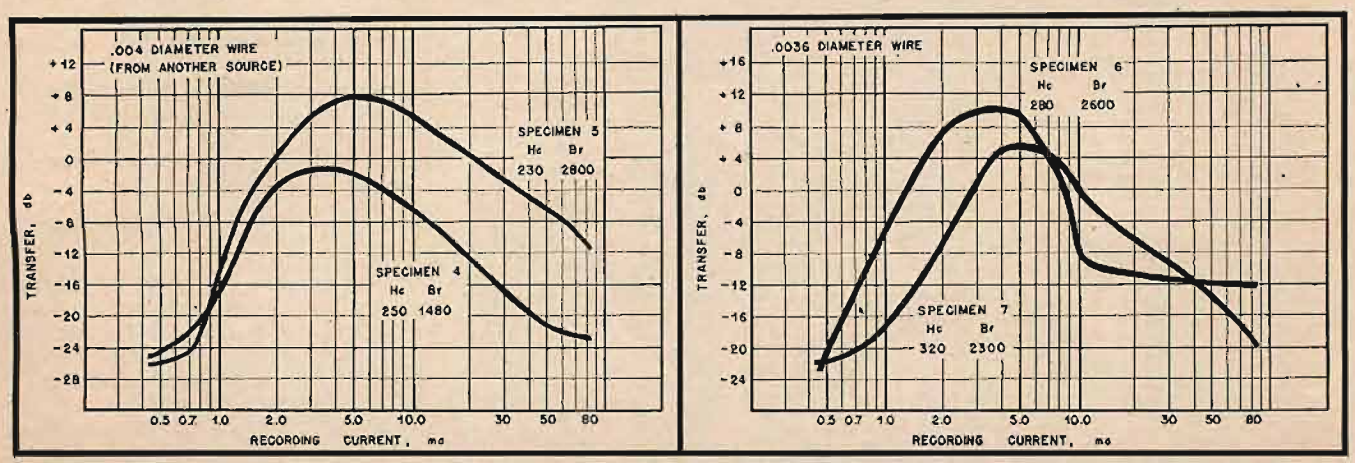


Fig. 4 (left). Transfer vs. recording current for two specimens of .004-in. wire from a different source than those of Fig. 1. Fig. 5 (right). Transfer vs. recording current for two samples of .0036-in. wire.

An Automatic Disc Recorder

CURTISS R. SCHAFER*

Time-saving is money-saving—in recording studios as well as elsewhere. The author describes a system whereby considerable time and attention is saved by making an operation partially automatic instead of entirely manual.

THE EQUIPMENT to be described was developed to meet the needs of the recording studio with a great deal of tape-to-disc dubbing work to do. Once the tape playback machine has been started, and the cutter head lowered onto the disc, the operation is almost completely automatic; that is, the program material will be dubbed to the disc with the proper spacing between selections, and both the disc and tape machines are stopped at the end of the program. Control of the disc cutter from the tape is accomplished through small pieces of Scotch tape which have aluminum foil on the outer side. These are stuck in place on the tape by the operator when he edits the tape, and act as miniature shorting bars which operate the appropriate relay on the recorder panel.

The automatic disc recorder is shown in *Fig.* 1. It is built around a Fairchild 539-G recorder which has been modified as follows:

1. A spiralling motor and overrunning clutch have been added.

2. A dual Micro-switch has been mounted on the left lead screw support so that when the cutter has finished the center spiral it strikes the switch actuator and a relay shuts off the turntable motor, stylus heat, and spiralling motor.

3. Other additions to the Fairchild unit are a suction pump and tube, a microscope, and spiralling and microgroove attachments.

Fig. 1. The control panel mounted adjacent to the disc recorder provides convenient operation.

Figure 2 is a diagram of the audio section of the panel. The program material leaves the tape (on an Ampex "400") via a 500-ohm line, goes into the T-pad, through the passive equalizer, to give the proper high-frequency characteristic for microgroove (LP) or standard (78-r.p.m.) recording, and out into a high-quality 30-watt power amplifier[1]. From the output of this amplifier, which is loaded with a 10-db isolation pad, it comes back to the panel and into the meter switch which sets the recording level at 20 dbm for microgroove and at 26 dbm for standard recordings when the meter indicates 0 VU. This switch also monitors the voltage (approximately 6 volts at 0 VU) across the heater coil in the thermostylus unit. From the switch and VU meter, the signal goes into the 500-cps crossover network (for bass equalization) and the cutter head.

Figure 3 is a wiring diagram of the automatic control section. The indicator lights, PL, are numbered 1, 2, 3, and 4 from right to left when looking at the front of the panel, and are associated with the switches just below them on the panel and correspondingly numbered on the diagram. Terminals AA lead to the heater coil on the thermostylus unit and terminals BB lead to the microscope light. The relays indicated are of the latching type. The 30-watt amplifier, suction pump, turntable motor, and spiralling motor are plugged into the twist-lock receptacles mounted on the rear of the chassis. Sw_3 is a push-button switch for manual control of stylus heat. Another push-button switch is used for manual control of separating spiralling if desired. On the octal socket at the left of the diagram, terminals 3 and 7 go to the section of the dual Micro-

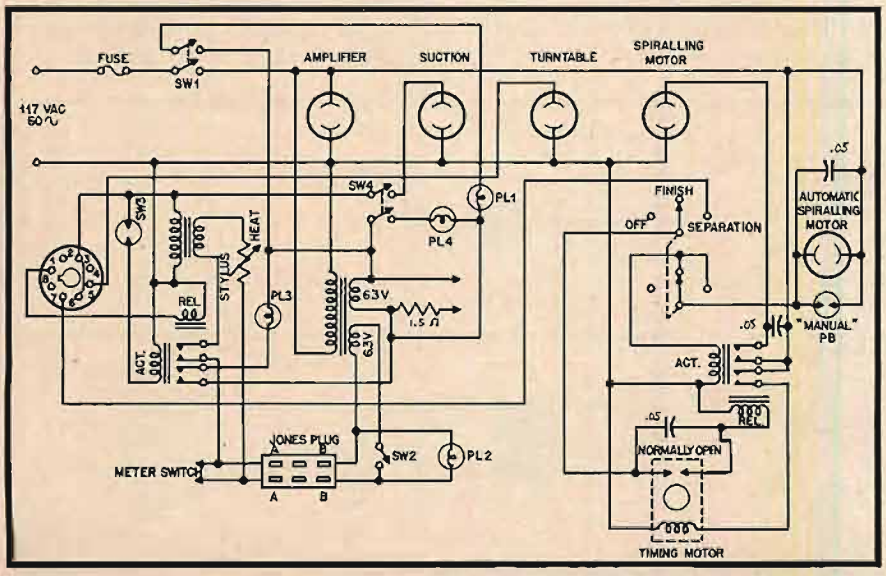


Fig. 3. Complete schematic of the power and signal circuits for operation of the disc recorder and its accessories.

Consultant to The Dubbings Company 41–10 45th St., Long Island City, New York.

[1] Curtiss R. Schafer, "30-watt high-fidelity audio amplifier", AUDIO ENGINEERING, July 1948, p. 21.

(*Continued on page 51*)

A New Wide-Range Phonograph Cartridge

JOHN F. WOOD*

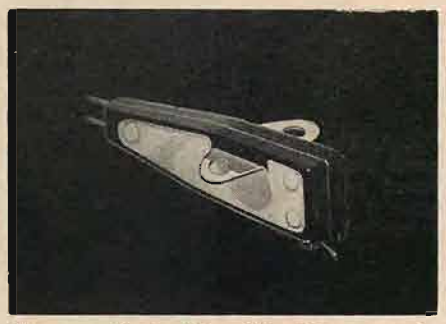
A description of the newest contender in the field of hi-fi reproduction. The principles of operation of the barium-titanate cartridge are outlined, and the economies of such a device are discussed.

FOR MANY YEARS the magnetic phonograph cartridge has been accepted as the standard of the industry and used in practically all professional and high quality reproducing systems. With specialized associated equipment, excellent response can be obtained over the major portion of the audio spectrum. While ideally suited for the constant velocity recording characteristic, there are definite disadvantages to the use of a velocity type of pickup on modern records. Until recently there has been little else available and the use of the magnetic cartridge has been accompanied with equalizing circuits and preamplifiers of increasing complexity.

With the development of the barium titanate piezoelectric element a new medium was available to the cartridge designer. Experience had been accumulated with the design and production of various ceramic cartridges for conventional phonograph use where high output and low cost were primary considerations. Accordingly, it was logical to pursue the development of a cartridge in which the full potentialities of the ceramic could be realized.

As the outgrowth of this program, the Electro-Voice Model 84 Ultra-Linear ceramic cartridge is presented to the music listener and professional as a cartridge eminently suited to the reproduction of modern records.

*Senior Engineer, Electro-Voice, Inc., Buchanan, Michigan.



The new Electro-Voice Ultra-Linear ceramic pickup cartridge.

Amplitude and Velocity

Unfortunately, a number of misconceptions have existed regarding cartridges and recording methods. In view of these misconceptions, a brief review of recording characteristics is desirable and follows in the paragraphs below.

Figures 1 and 2 are shown to clarify the relation between velocity and amplitude. The waveform is that of the record groove with frequency increasing toward the right. The frequency scale has been reduced because of limited space. According to the equation:

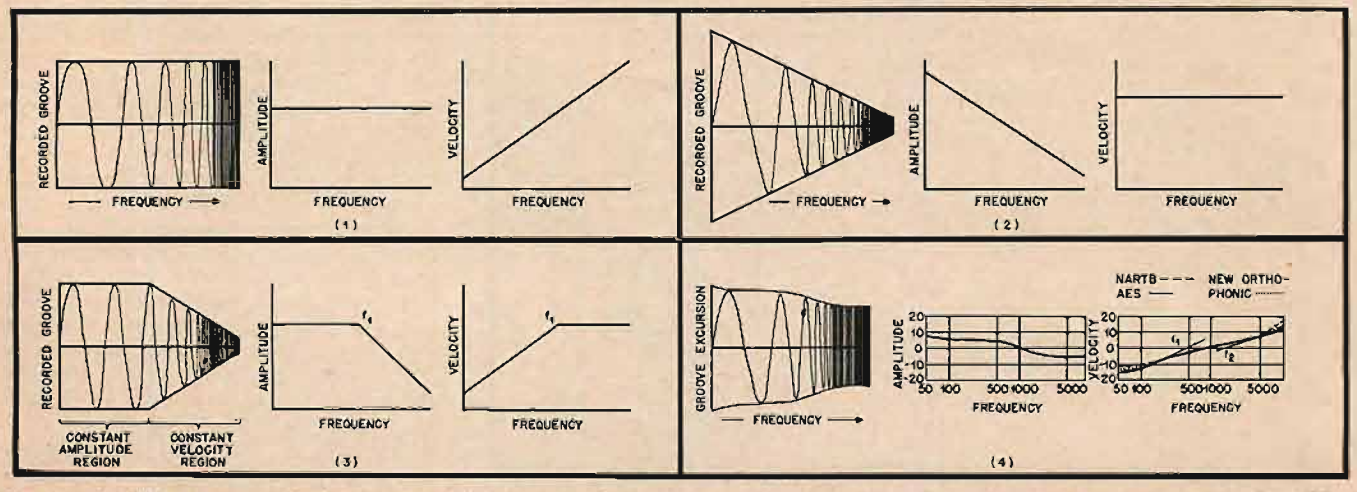
$$V = 2\pi f A$$

where V = velocity of a stylus moving laterally with the longitudinal motion of the groove,
f = frequency
A = amplitude of groove excursion,

velocity will increase with frequency for a given amplitude at the rate of 6 db per octave. Conversely, amplitude will decrease with frequency for a given velocity at the rate of 6 db per octave. The statement is often made that a cartridge or system is "flat." To be accurate it is necessary to indicate the reference to constant amplitude, constant velocity, or some recording characteristic such as the New Orthophonic or National Association of Radio and Television Broadcasters recommended curves. For example, a velocity-flat cartridge would not reproduce a modern music record with an Orthophonic characteristic without considerable equalization.

Origin of Recording Characteristics

The origin of constant-velocity recording goes far back into the history of sound recording. The old acoustic recording method, with elaborate horns and strong voiced artists, utilized essentially a velocity characteristic. The first electric cutters were of the magnetic type and recorded with a 6 db per octave descending slope on an amplitude basis. When played back with a magnetic pickup with the inherently inverse characteristic, the result was a flat reproduction of the original sound. Since the amplitude of the groove can become quite large at the lower frequencies, a reduction in level below some arbitrary crossover point was necessary to prevent the overcutting of one groove into the



Figs. 1 to 4. (1) Constant amplitude operation. (2) Constant velocity operation. (3) Standard frequency test record characteristic. (4) Modern recording characteristics.

(Left) Production testing of compliance, using a magnetically driven vibrating reed which is loaded by the stiffness of the cartridge. The change in amplitude of vibration is read from the meter which is calibrated directly in compliance—the reciprocal of stiffness. A high value of compliance is necessary to prevent distortion and actual damage to the record groove. (Right) Production testing of output voltage and frequency response. Voltage output at 1000 cps is indicated on the meter while playing a test record, and frequency response is checked within a 2.5 db envelope on the face of the oscilloscope over the range from 50 to 10,000 cps. The source for this test is a sweep-frequency record.

next. At this crossover point the transition was made electrically from constant velocity to constant amplitude. This characteristic is shown in *Fig.* 3 and is still used for a number of standard frequency test records.

When interest was aroused in the more natural reproduction of sound, it was found that the signal-to-noise ratio was very poor. This was true because of the small groove amplitude at the higher frequencies. Consequently, high-frequency equalization was provided for the cutters in various degrees until, today, records are cut with very nearly a constant-amplitude characteristic. Variations from this characteristic exist for several reasons. The first reason is to facilitate design of equalizing networks. Another involves improvement in needle tracking at the high frequencies. Variations are often made by the recording engineer to compensate for acoustic deficiencies and to produce special effects.

The NARTB, AES and New Orthophonic characteristics are shown in *Fig.* 4. The crossover points still exist but do not have the significance of the old transition point. The lower point is shown at 500 cps (f_1) and the upper point at 2120 cps (f_2). Because of the gradual transition, the crossover can be defined as the intersection of the asymptote or tangent of the curve with the 1000 cps level.

Obviously, the correct reproduction of these curves requires compensation of any magnetic cartridge, whether it be variable reluctance, moving coil dynamic, or other. These cartridges operate in accordance with Faraday's Law:

$$e.m.f. = \frac{d\phi}{dt}$$

where $e.m.f.$ = the generated electromotive force,
N = the number of conductors in the field,
$\frac{d\phi}{dt}$ = the time rate of change of magnetic flux.

For this reason this class of cartridges is referred to as the velocity type.

For the magnetic cartridges, equalization is usually accomplished by a rising gain in the preamplifier of about 6 db per octave below the lower crossover point. As the magnetic cartridge is inductive, high-frequency equalization can be accomplished by shunting with a load resistance of the proper value, as is done in some preamplifiers. In others this is done in other sections of the circuit.

The effects of this extensive reshaping of the response curve can now be considered. As mentioned above, the cartridge is inductive and is therefore susceptible to hum pickup from stray magnetic fields. These fields are produced by phonograph motors, transformers, and other electrical equipment. At 30-cps, the output of this cartridge is 18 db below the 1000-cps level, or from 1.25 mv to 5 mv in an average cartridge. Amplification of this low-level signal will increase the hum along with the signal. Furthermore, there is the consideration of tube and circuit noise which is always a problem in low level amplifier design.

The Barium Titanate Transducer

Barium titanate is a true ceramic material, similar to the material used in an ordinary tea cup. However, barium titanate possesses the unique ability to generate an electric charge when subjected to mechanical stress. This phenomenon is known as the piezoelectric effect. In such an element the generated e.m.f. is proportional to the mechanical strain in the material. Because of this phenomenon, pickups utilizing the piezoelectric effect are referred to as amplitude or displacement devices.

A typical element consists of two slabs of barium titanate separated by an electrode surface which may be a metal strip or a deposit of silver. (See *Fig.* 5.) Electrodes are deposited on the outside surfaces and the entire assembly is charged by the application of a high voltage, just under the breakdown potential. This "charge" accomplishes an orientation of the molecular structure and produces piezoelectric sensitivity. A bending force applied to the element will stress one side in tension and the other in compression. The generated voltages of the two slabs are usually added in series to provide maximum output.

While the piezoelectric effect has been widely used in cartridges with Rochelle Salt or ammonium di-hydrogen phosphate (ADP) generating elements, certain characteristics limited their use for the conventional home phonograph. The higher output voltage of the Rochelle Salt element is offset by its susceptibility to damage by excess humidity and its dehydration by exposure to extreme dryness. Furthermore it dissolves in its water of crystallization at 130° F. ADP is better in these respects but has a much lower dielectric constant. On the other hand, the barium titanate element is completely resistant to moisture, is unaffected by temperatures up to and above 212° F., is relatively strong, and has a very high dielectric

(*Continued on page 52*)

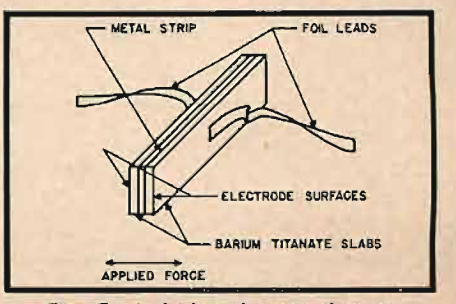


Fig. 5. A barium-titanate element.

How to Brace a Speaker Cabinet—

Vibration Reduction in Loudspeaker Enclosures

G. B. HOUCK*

Presenting the reasons for bracing a bass-reflex loudspeaker cabinet, and showing how to do it with the assurance of improved performance when the job is completed.

BENJAMIN FRANKLIN once observed that "Empty barrels make the loudest noise." In this case he was referring obliquely to the common phenomenon of uninformed vociferation, not describing the performance of a loudspeaker enclosure. G. A. Briggs, in the second chapter of "Sound Reproduction," was commenting on the latter when he wrote: "The indications are that the effect of cabinet resonance has been underestimated in the past." He observed that the tone-quality of reproduced sound was greatly improved when the loudspeaker cabinet was constructed of materials having a high density. In a paper presented before the IRE PGA[1], Frank McIntosh pointed out that "boomy" sounds are caused by acoustic radiation due to decaying vibration of the panels in a poorly braced cabinet.

Briggs offers one solution to this problem—make the panels massive and they won't vibrate. The principle involved is that of relative momenta. Consider the effect of a moving mass of air striking a panel. Referring to *Fig.* 1, if a unit volume of air having a mass M_1, and an instantaneous maximum velocity V_1 strikes a unit volume of panel having a mass M_2, initially at rest, both masses will have a resulting velocity V_2. This relationship may be written:

$$M_1V_1^2 - M_2O^2 = (M_1 + M_2)V_2^2 \quad (1)$$

Note that for the optimum condition, V_2 approaching zero (panel does not move) it is necessary to have the ratio of M_2/M_1 as large as possible. Since M_1, the mass of air is fixed at roughly 1/13 lb./cu. ft., M_2 remains the only variable. By varying M_2, it is possible to obtain the ratios shown in Table I for several different materials. It appears obvious from a glance at this table that a small improvement in V_2 (hence a reduction in vibration) may be had only at the expense of a large increase in weight. For example, a panel made of concrete would tend to vibrate (other things such at the modulus of elasticity being equal) 1/4.5 times as much as one made of wood, but would weigh 20 times as much. Thus a typical bass reflex cabinet weighing 50 pounds constructed of wood, would weigh 1000 made of concrete—probably too much for the average living room floor to support. Even if this were permissible, such an enclosure would be virtually immovable and would present the baffling (no pun intended) problem mentioned in a recent editorial.[2]

TABLE 1

Physical Properties of Common Construction Materials

Material	Mass lbs./ft.³	Thick. In.	M_2 lbs./ft.²	M_2/M_1	V_1/V_2
Dry packed sand	105	1	8.75	114	10.7
Brick	125	3	31.2	406	20.2
Concrete	150	3	37.5	488	22.1
Plaster	—	1	8.0	104	10.2
White Pine	26	7/8	1.9	24.7	4.9
White Oak	46	7/8	3.36	43.8	6.6
2-7/8 wood panels with 1" sand between			12.55	163.5	12.8

Fortunately for the cabinet designer there is another solution to the problem of reducing panel vibration. Instead of relying on weight alone to accomplish the desired results, he can make the panels stiff, and join them rigidly together.

Stiffness of Panels

Several factors determine the stiffness of a panel. The chief factor of course is the geometry of the panel. In most cases it is very difficult to analyze the behavior of a vibrating plate, especially if one attempts to relate various design parameters to a resulting acoustic output. It is entirely beyond the scope of this discussion to examine these theoretical considerations in minute detail. Furthermore, it can be shown that a much simpler method of analysis provides the essential information necessary to make very substantial improvements in cabinet construction.

For all practical purposes it is reasonably sufficient to consider a panel as made up of an infinite number of small beams arranged side by side as shown in *Fig.* 2. Notice that in this type of analysis, the beams are represented as extending across the shorter dimension of the panel. Assuming the edges of the panel are supported, it is logical to suppose that the beam exhibiting the most severe deflection when subject to a load, will be one near the center of the panel such as beam A. Now, without attempting to determine an exact coefficient for the stiffness factor, it can be shown that the maximum deflection of beam A is dependent on a few easily determined variables. Actually, since the beams are integral parts of a homogeneous plate, the deflection will be somewhat less than that of a single unattached beam.

The equation for the deflection of a rigidly supported, uniformly loaded beam may be written as

$$Z = \frac{W L^3}{384 E I} \quad (2)$$

* *General Precision Laboratory, 63 Bedford Road, Pleasantville, N. Y.*

[1] IRE Professional Group on Audio, No. 10. September, 1952.

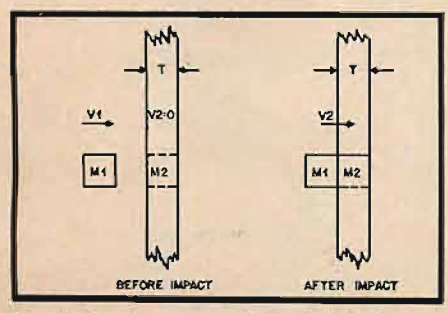


Fig. 1. Kinetic energy effect of Unit Volume of air M_1, impinging on Unit Area of panel, M_2.

[2] EDITOR'S REPORT, AUDIO ENGINEERING, March, 1953.

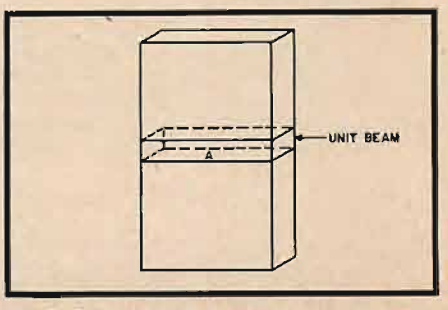


Fig. 2. Typical panel as used in the discussion.

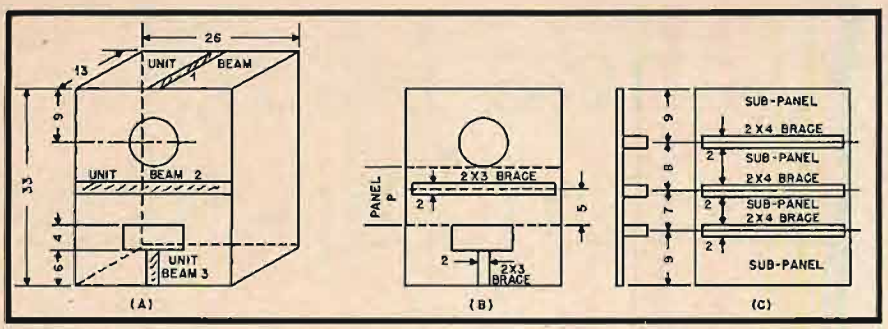


Fig. 3. Typical bass-reflex enclosure, with dimensions as used in the sample problem. All stiffening beams are mounted so that their maximum cross-section dimension is perpendicular to the plane of the panel.

in which Z equals the maximum deflection, W equals the load on the beam (maximum instantaneous value), and I equals the moment of inertia of the cross-section of the beam. If this equation is compared with that for a non-rigidly supported beam, in which case

$$Z = \frac{5\ W\ L^3}{384\ E\ I} \qquad (3)$$

it will be observed that the deflection is five times the magnitude of the former. Of course in actual practice these extremes are almost never encountered; no panel however loosely secured would exhibit a vibration five times as severe as one firmly attached to an immovable support. Nevertheless, this simple comparison emphasizes the need for rigid support of the panels.

The maximum deflection of such a beam may also be reduced by decreasing its length as far as is practicable. On the other hand, little benefit is derived from attempting to vary the value of E; reference to appropriate tables reveals that the modulus of elasticity of commonly used lumber varies from about 1.00×10^6 to 1.6×10^6.

The moment of inertia of these beams equals $bd^3/12$, where b is the width of the beam and d is its thickness. (See Table II) It is interesting to note here that doubling the thickness of a panel (and hence the thickness of a unit-width beam) reduces the deflection by a factor of eight; tripling the thickness reduces deflection by a factor of 27; and so on. Before demonstrating a typical solution to a cabinet design problem, it will be found helpful to introduce one further beam equation into the discussion. In the case where a panel contains an opening (speaker mounting hole or reflex port), the beams which have one termination at an opening are classified as cantilevers. The deflection for this type of beam is written as:

TABLE 2

Moment of Inertia about the Center of Gravity for Common Lumber Sizes (max. Value)

Nominal Size In.	Dressed or Finished Size In.	Moment of Inertia In.⁴
1 × 1	⅞ × ⅞	.049
1 × 2	⅞ × 1⅝	.31
1 × 3	⅞ × 2⅝	1.32
2 × 3	1⅝ × 2⅝	2.45
1 × 4	⅞ × 3⅝	3.44
2 × 4	1⅝ × 3⅝	6.45

$$Z = \frac{W\ L^3}{8\ E\ I} \qquad (4)$$

For convenience, the terms in the equations which remain more-or-less constant in any one design, are W and E, and they may be lumped into one constant, K. The equators are then rewritten as:

Simple beam—no end supports

$$Z = \frac{5\ K\ L^3}{384\ I} \qquad (5)$$

Simple beam—fixed end supports

$$Z = \frac{K\ L^3}{384\ I} \qquad (6)$$

Cantilever

$$Z = \frac{K\ L^3}{8\ I} \qquad (7)$$

Figure 3 and the sample problem show the suggested method of analysis as applied to a typical cabinet. Cabinets of different shapes will present stiffness problems somewhat different from the sample illustrated. In this case, the analysis is used to determine the size, shape, and number of braces required to improve the performance of a cabinet originally constructed without full consideration of the factors just discussed. Naturally the need for extensive bracing is reduced if the enclosure is properly designed from the start.

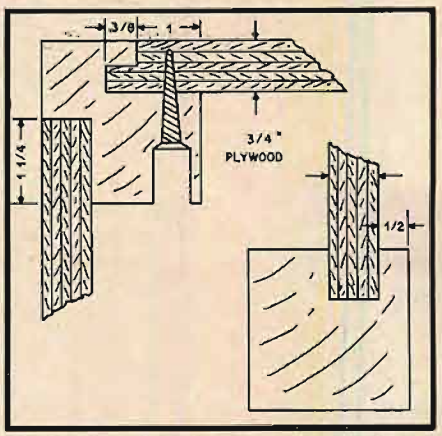


Fig. 4. Examples of cornerpost construction.

Construction

There is more to the problem of designing a rigid speaker cabinet than mere choice of adequate panel thickness and arrangement of bracing, however. As was observed from the discussion of the beam equations, above, the method of supporting the panels is highly important. Since most panels are made of plywood, it is necessary to insure that all joints are constructed to achieve the maximum possible rigidity. A simple but effective method for accomplishing this is to use corner posts to which the panels are securely anchored. A few typical joints of this type are illustrated in *Fig.* 4. It will be found that such methods also contribute to the over-all appearance of the finished structure.

At first glance, the prospective builder may be somewhat dismayed by the suggestion that special tools are needed to prepare the joints for assembly. This type of work is best done using a joiner or router, although the patient craftsman may use a plane with very good results. In many instances the whole problem can be greatly simplified by having a local mill cut each piece to size and prepare the joining surfaces from drawings furnished by the designer. The task, then, is merely one of assembling the finished parts.

During this assembly operation it is best to screw and glue all joints together so that the finished cabinet will be tight and solid. The front panel of the enclosure can also be permanently anchored if the loudspeaker is mounted as shown in *Fig.* 5. It is fairly well recognized that speaker performance is greatly improved by mounting the speaker in this manner. As illustrated, an alternate method using two superimposed panels obviates the necessity for special routing. In either case captive nuts attached to the back of the panel receive the speaker mounting bolts from the front. Many loudspeaker manufacturers will, upon request, supply suitable gaskets for this type of mounting.

Conclusion

It has been the purpose of this discussion to analyze the problem of spurious acoustic output caused by excessive panel vibrations in a loudspeaker enclosure, and to suggest an approach which will result in a definite reduction in the effect and a vast improvement in the over-all performance. As might be

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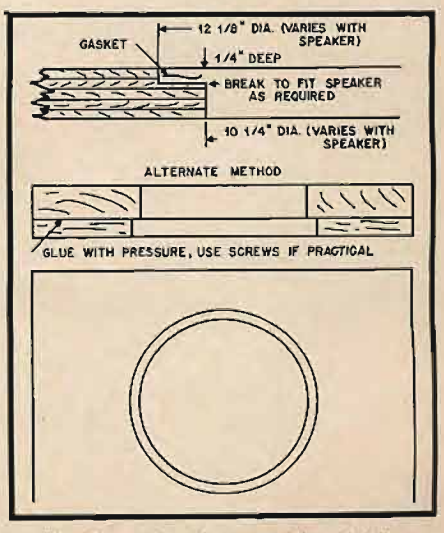

Fig. 5. Loudspeaker mounting details.

Tired Business Man's Radio Cabinet and Speaker

C. G. Fraser*

Music-time means relaxation for many—but when there is no cabinet available which provides the convenience demanded by the t.b.m. at the end of a hard day's work, the solution is best arrived at by a cut-and-try building operation—as described here.

THE ACCOMPANYING PHOTOGRAPHS represent the culmination of some seven or eight years of interesting and satisfying work in the hobby of sound reproduction. *Figure* 1 shows a radio, turntable, and amplifier cabinet recently completed, the design of which incorporates a few interesting features. The height of the cabinet has been selected to stand even with the arm of a chair in such a manner as to be of maximum convenience to the operation of either the radio or the turntable. The chair which normally stands beside the cabinet has been removed for photographic purposes. A considerable amount of thought has gone into this design in an attempt to overcome what we regard as disadvantages that appear in nearly all other designs of cabinets. Most cabinet designs fall in two general categories: (1), Controls positioned for operators who prefer to lie on the floor; and (2), Controls positioned for people who prefer to stand facing a blank wall. The design shown has all controls at finger tip reach while sitting comfortably in a chair. The cover to the turntable rolls back at finger tip touch. A detail of this operation is shown in *Fig.* 2.

The equipment used consists of a Meissner AM-FM tuner, Rek-O-Kut turntable, Clarkstan tone arm, Pickering pickup and record compensator, and preamplifier.

*7516 N. Boyd Way, Fox Point 11, Wisc.

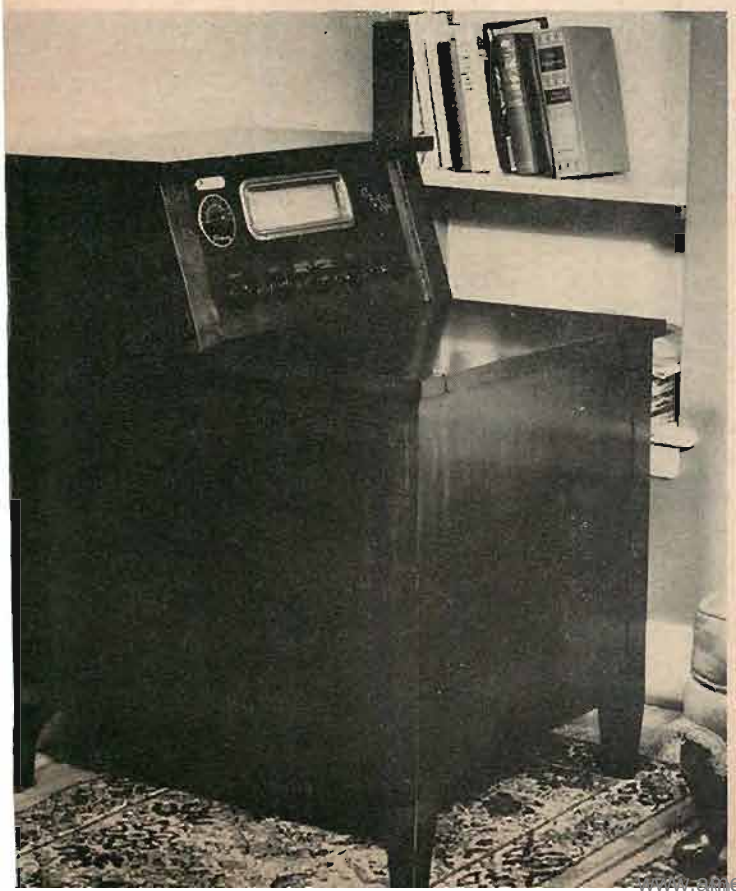

Fig. 1. Combining simplicity of construction and ease of access, this "home-made" cabinet houses the turntable, phono preamp and controls, radio tuner, and the power amplifier.

The turntable is mounted partly beneath the tuner so as to shorten the cabinet as much as possible from front to back. Since all controls are still readily accessible, nothing is lost by this overlap. The record compensator is offset by means of flexible couplings. The purpose here is to be able to cluster the control knobs within easy reach on the front panel. A neon glow lamp over the compensator dial indicates when the turntable is in operation. Small lamps placed on the two front corners of the turntable compartment turn on when the cover is rolled back. The top of the tuner compartment has a hinged cover to facilitate tube replacement.

The 15-watt amplifier used in this equipment was built from a UTC design and incorporates a UTC tone control which has been permanently fixed to give 10 db of bass boost and 5 db of treble boost. This tone control as sold has a low-frequency peak at 50 cps and a high-frequency peak at 8,000 cps. This was unsatisfactory for best operation of the speaker system so the unit was taken apart and capacitor values changed to give a low-frequency peak of 27 cps and a high-frequency peak of 14,000 cps. A little work on a Saturday afternoon and a can of hot oil will do it.

THE LOUDSPEAKER

The development of the speaker system has taken place in parallel with the other equipment which confirms the statements so frequently heard that perfection of one component uncovers the failings of another component. *Figure* 3 illustrates what was once a Stephens bass-reflex cabinet. In this connection the number of articles which have been written dealing with ways and means for improving the operation of a bass reflex cabinet might be taken as an indication that certain people are dissatisfied with this type of reproducer. That, at least, was the writer's experience. The original speaker used in this cabinet was an Altec 603. As perfection of various components was achieved, it became increasingly evident that the speaker-cabinet combination could stand some attention.

At about this time an opportunity occurred to witness the performance of a folded horn installation. After studying various literature which is available from the library on sound in general and folded horns in particular, it seemed that it was worth a try to remodel a good bass reflex cabinet in hopes of improving the performance with a homemade and rather poorly engineered exponential horn. After a considerable amount of doodling on graph paper, it was possible to design a horn 56 in. long and with a 19-in. flare within the dimensions of the original cabinet. Next came the problem of using the present speaker if possible,

lar tweeter was selected for two reasons: The cross-section of the horn is small enough that it can be placed within the larger horn with a minimum of interference, and the driver can be removed without the use of a screw driver. Obviously this driver is far inside the cabinet where no tools can be used. The standard crossover frequency for the University tweeter is 600 cps. This was a matter of some concern because all literature on the subject indicates that a cut-off of 400 or 500 cps is necessary for this type of cabinet. Probably it is again fortunate that no instruments have been put on the cabinet or probably it is because of the 6 db of attenuation in the cross-over frequency, but any missing notes in the 500–600 cps zone simply cannot be detected. As a further safeguard towards a break in response the folded horn was constructed of 5/8-in. Weldwood, which is an all birch plywood, then finished with hard enamel.

If there is any conclusion that can be drawn from this type of progress, it is that the man without technical knowledge must be satisfied to make his progress slowly. He must also anticipate a mistake now and then, and most of all he must be satisfied to imitate the work of others. There probably is not a good original idea in this entire paper. Anything that might be classed as purely original would probably be also classed by the technical boys as undesirable.

The performance of the unit, at least so far as the ear is concerned, is good. It appears to reproduce 32-cps fundamental tones well, although the only available source of this material is an FM broadcast of live pipe organ music.

(*Continued on page 59*)

With the controls for the radio tuner at arm level when the user is seated, as indicated in Fig. 2 above, listening can be a pleasure uninterrupted by the need for jumping up and down to change stations or records. The loudspeaker, shown in Fig. 3 below, is located across the room. The cabinet was modified from a standard model.

and perhaps this illustrates to perfection the adage, "Fools rush in where angels fear to tread." The high-frequency horn of the 603 speaker was removed. It probably was fortunate at the same time that some damage occurred to the voice coil, so for something like $13.00 a new copper voice coil and cone to convert the speaker to a standard Altec woofer was installed. The change was simple but it appeared as though the 57-cps resonant frequency of this speaker should be lowered if possible. After obtaining as much advice as possible the periphery of the cone was sandpapered and a large portion of the voice-coil diaphragm was cut out. This was a step by step operation, each one a little bolder than the one before, until it was possible to get the resonant frequency down to 32 cps. It might be added however, that the paper cone by this time had been sanded so thin that it was transparent. An application of rubber cement closed the pores and made it substantially air tight. It was necessary also to close the center of the cone and to open up relief ports in back of the diaphragm. This entire venture would make Mr. Hilliard feel bad but there seem to be some advantages in not having test instruments because if the quality of the tone of this speaker has been adversly affected, it is not apparent to the ear.

The next problem was the selection of a high-frequency unit. Note that this folded horn does not have the "Queen Mary super structure" that is common with this type of enclosure. The high-frequency unit is here but it is not in sight. The actual installation was made by the selection of a University cobra unit. The horn is mounted permanently within the convolutions of the low-frequency cabinet. The driver, however, can be reached from the back of the cabinet and removed by unscrewing if necessary. This particu-

The 1953 Audio Fair in Review

HARRIE K. RICHARDSON*

AFTER PREMISING a number of these annual observations on the growth of Audio as an industry, it is somewhat relieving to discover that the path of this year's wordage leads directly to evaluation of Audio as a market.

In Fairs gone by—even as recent as last year—there has been present the lagging indication of two disturbing situations.

(1) Audio manufacturers, with few notable exceptions, were not on a common ground of understanding with the prospective buyers of their equipment. Too often they placed themselves in the position of selling 'scope traces and printed specifications, overlooking the inability of their audience to interpret technical demonstrations in terms of living-room performance.

(2) Buyers of home music systems as a whole had not equipped themselves with the basic knowledge necessary for intelligent selection of the system's various components. There was far too much of the "I-don't-know-from-nothing, technically-speaking" attitude.

On the one hand, you had the engineering brethren describing their audio progenies in a vocabulary which was virtually meaningless to their listeners. On the other hand the listeners, not to be outdone, blossomed forth like a mass migration of Deems Taylors with an effect which was equally bewildering.

The 1953 Fair witnessed the meeting of the twain. One could take his choice and use *low-frequency boost* or *basso fortissimo* with reasonable assurance of conveying the desired connotation to whomever he was speaking, be it music lover or engineer.

In essence, the 1953 Fair marked the moment in audio history when the professional engineer and the embryonic hobbyist met each other half way. Engineers deserted their slipstick terminology and spoke in terms of musical values, while music lovers met the challenge by tossing around such words as *frequency response, distortion,* and *equalization* with full knowledge of their meanings.

Credit without limit is due both groups. Because, within the space of a single year they have solidified a basis of mutual understanding which has long been needed.

Clearly evidenced by the scope of the 1953 Fair was the fact that the audio industry has at last become a major commercial entity. No longer is it accorded the paternal pat of condescension by major manufacturers, nor is it accepted with resignation as a necessary evil by the larger recording companies. If there be clearer proof that audio has passed twenty-one, this reporter remains to be so enlightened.

Herewith the observations which stand uppermost as relief at the passing of the 1953 Fair gives way to anticipation of the one scheduled for 1954.

"An audio engineer's dream" could well be the title of the display presented by **Acro Products Company.** Acrosound transformers, Ultra-Linear amplifiers, and a host of other precision audio devices made up an exhibit which was easy to take and hard to leave.

Featured in the exhibit of **Alpha Wire Corporation** was the release of the company's new catalog 153-S, which is concerned exclusively with wires and cables for use in sound equipment. This catalog dramatizes the extent to which Alpha has gone in keeping pace with the audio industry. Also on hand was a complete display of Alpha products.

The major portion of the **Altec Lansing Corporation** exhibit was devoted to stressing the purely home atmosphere of high fidelity. Five tastefully arranged groupings of typical living room furniture successfully dispelled the idea that special cabinetry is needed for a high-quality home music system. The remainder of the Altec display consisted of a miniature anechoic chamber with transparent sides, in which an Altec Duplex speaker was put through tests to show the basis of its unconditional guarantee of frequency response from 30 to 22,000 cps.

Genuine stereophonic sound—the kind reproduced with three or more recording channels—was the highlight of **Ampex Corporation's** showing of the Model 350-3 stereophonic recorder. Housed in three portable cases, the 350-3 is perfectly suited for location recording in the production of 3D motion pictures with dimensional sound. So realistic were the recordings used to put the equipment through its paces, that only the difference in acoustical surroundings prevented virtual duplication of the live performance. Of more realistic interest to Fair visitors were the new Ampex Model 350 recorder console and the Model 450 continuous tape reproducer.

Newspaper and magazine correspondents, as well as radio and TV commentators that covered the Fair—and many they were—migrated quite naturally to the suite occupied by **Amplifier Corp. of America.** Here they were treated to an outstanding display of a device which is rapidly becoming a staple tool of their profession—the miniature, portable tape recorder. Of the many models of Amplifier Corp.'s Magnemite recorder exhibited, interest was centered on the new battery-operated-motor unit which affords every recording facility within a small case and weighs but eight pounds.

Known principally for the excellent motion picture equipment the company has manufactured for many years, **Ampro Corporation** has successfully transferred its enviable reputation to the audio field with a new line of tape recorders. Available in a number of models, the new Ampro recorders are exceptionally fine performers within their various price ranges.

One would have to travel far and wide to discover more appealing examples of audio cabinetry than that shown by **Angle Genesee Corporation.** Custom-built, well-constructed, and acoustically-correct, the enclosures on display were the subject of many complimentary observations.

Imagine, if you can, a competent concert pianist playing the well-known Chopin Polonaise; suddenly her fingers leave the keyboard, yet the music continues without noticeable change. This was the dramatic means chosen by **Audak Company** to demonstrate the realistic performance of the Audak Polyphase Chromatic reproducer. Unchallenged was the opinion of audio engineers and fans alike that the Audak pickup passed this most trying of tests with flying colors.

The dominant theme of the **Audio & Video Products Corporation** exhibit was based on the completeness of the products handled by the company for radio stations and professional recording studios, with primary emphasis being placed on tape recording equipment and accessories. Among the well-known trade names in evidence were: Ampex, Altec, Electro-Voice, McIntosh, Cinema, Tapak, and Telefunken. Also of great interest was the display of

* *Associate Editor, Audio Engineering*

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Beam W/B Stentorian speakers, British-made by the world-famous Whiteley Electrical Radio Company, complement to the fullest extent the most modern achievements in hi-fi recording and in amplifier design—provide vivid realism, high sensitivity, and a degree of musically satisfying *balance* never before attained in a speaker.

The wonderfully smooth performance of Stentorians over an extended range is made possible by W/B Beam's new "Fibre-tone" diaphragm and cone process... and by the patented, brilliantly-designed twin concentric drives (duplex). And Stentorians are made entirely by *one organization;* every component, without exception, is manufactured under one roof, to strict quality specifications. *Compare price and performance,* and you'll want to own one of these remarkable speakers.

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Ideal with any cone speaker. Response, 2,000 to 20,000 cps. Coil impedance, 15 ohms. Power handling, 15 watts. Rigid construction. Prices: T 10 (5 watts), $17.95; T 12, $45.00

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pre-recorded music-on-tape shown by the A-V Tape Libraries division. No doubt about it, this rapidly growing library of recorded tape offers a challenge to the disc companies which now occupy the major portion of the home music market.

The thoroughness with which **Audio Devices, Inc.**, penetrates the field of recording materials was well evidenced by an attractive exhibit which included the entire line of Audiodiscs and Audiotape. Stressed in the display was a large wall board devoted to the theme,—"Of the 30 best selling records of 1952, 29 used Audiodiscs for the master recording." The black sheep, incidentally, was a London record made abroad.

Packaged high-fidelity equipment of unsurpassed appeal to both eye and ear was shown by the Appliance and Electronics Division of **Avco Manufacturing Corporation.** Spotlighted was the Crosley "Enrico Caruso" FM-AM radio-phonograph. This unit is housed in two matching cabinets, one for record changer, tuner, and amplifier; the other is an acoustically-engineered speaker enclosure. Although the Avco display was essentially high fidelity in character, a small portion was devoted to the complete line of Crosley Coloradios, portables, and a new portable clock-radio-phonograph.

A relative newcomer to the high-quality audio industry is **Beam Instruments Company,** American distributor for England's famous Acoustical QUAD amplifier, first shown in this country at the 1951 Audio Fair, and the Stentorian line of high-fidel-

ity speakers, also manufactured in England. Especially interesting was the Stentorian "Quadruplex," an 18-in multispeaker which has four independent voice coils and diaphragms matched to a built-in crossover input; power rating is 30 watts. All Stentorian speakers are constructed with a cambric cone and surround, and as a result have remarkably low fundamental cone resonance. Also shown was a group of striking enclosures manufactured by Beam for housing the various types of speakers.

The Fair offered no more complete showing of high-fidelity amplifiers than that of **Bell Sound Systems.** Beginning with the low-power Model 2122B and continuing through the higher powered remote-control Model 2145A, Bell presented an amplifier for every home music requirement. Sharing honors with conventional amplifiers was the new Bell binaural amplifier which was demonstrated with remarkable effectiveness. Also displayed were tape and disc recorders, and two high-fidelity transcription-playing units.

You can always count on **Berlant Associates** for equipment displays which are both entertaining and informative. This year's showing was no exception, featuring as it did four Concertone high-quality tape recorders which cover the needs of both professional recordists and advanced audio hobbyists. As in previous years, gracious Bert Berlant, company president, was on hand to explain the whys and wherefores of the fine recorders his firm manufactures.

There's no better example of growth in the field of high fidelity than **David Bogen Company,** whose exhibit was one of the Fair's more pretentious. So complete is the Bogen line of tuners and amplifiers that it satsifies everyone from the budget-minded to the connoisseur whose only criterion is perfection. The highlight of the Bogan exhibit, at least to this observer's way of thinking, was the "decorators' corner"—an assembly of tasteful furnishings which proved beyond doubt that a home music system must not necessarily be an eyesore.

The expanding diversity of the company's line of high quality speakers was emphasized in the display of **R. T. Bozak Company.** In addition to speakers themselves, Bozak is now merchandising an assortment of enclosures which are impressive in performance and stunning in appearance. Outstanding is the model which houses two matching speaker systems, and which may be used with equal effectiveness for either stereophonic or monaural reproduction.

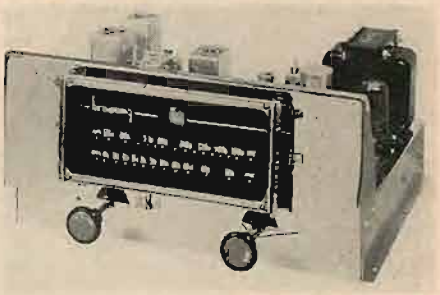
Personalities were the order of the day in the exhibit of **British Industries Corporation,** with G. A. Briggs and Harold Leak, both noted audio authorities from across the water, on hand to demonstrate and discuss the equipment with which they are most closely identified. Mr. Briggs who, in addition to having written many books on sound reproduction, designs Wharfedale

speakers, thrilled visitors with a three-way speaker system mounted in a corner cabinet whose hollow walls were filled with sand. Mr. Leak, as might be supposed, had paternal interest in the amplifier which was used in the demonstration. Mr. Briggs, in his first appearance at an Audio Fair, found a deep spot of affection in the hearts of his American contemporaries—while Mr. Leak, an Audio Fair veteran, was received with the welcome of an old and respected friend.

One of the real pioneers in the audio industry, Victor Brociner, president of **Brociner Electronics Laboratory,** presided over his company's display of a magnificent-sounding new speaker system, a new power amplifier, and the well-known Brociner audio control system. Of particular interest was the Model 4W wall horn, designed for use in rooms where a corner speaker is not feasible. Powered by a twin-cone driver unit, the 4W has in effect a "built-in" corner, and provides performance equal to that of the original Brociner Model 4 corner horn, without requiring corner placement. Styling of the enclosure is both conservative and graceful.

Sticking to a tradition which was established with the first Brook amplifier, **Brook Electronics** features the use of low-mu triodes throughout in the new Model 22A, which resembles in appearance the Brook Model 7 preamp and is but little larger. Attractively finished in gold and brown, the 22A is the first completely enclosed amplifier Brook has built. Output power is 10 watts and controls include input-selector switch, variable record equalization, bass boost, treble cut, and compensated volume control.

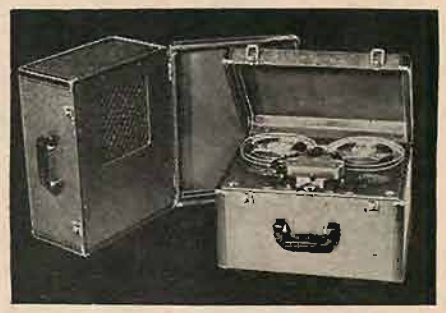
Along with exceptional tuners, there was displayed a high-quality amplifier in the exhibit of **Browning Laboratories.** Featured was the new RJ-42 AM-FM tuner, a new precision-built unit which offers wide-range reception and is virtually free of annoying



drift. Although precision-built, the RJ-42 is designed for operation by the non-technically-inclined music lover, having only two control knobs—one for tuning both bands, the other for channel selection, AFC control, and switching on and off. A screwdriver adjustment on the rear of the chassis is used for setting the tuner's output level to match that of other input devices.

The Columbia "360", first of the two-speaker high-fidelity table-model phonographs, together with the matching XD speaker for stereophonic effect, was featured in the exhibit of **Columbia Records, Inc.** CRI deserves a special pat for the courtesy and attention which were accorded visitors by genial Bill O'Boyle, national sales manager of the phonograph division.

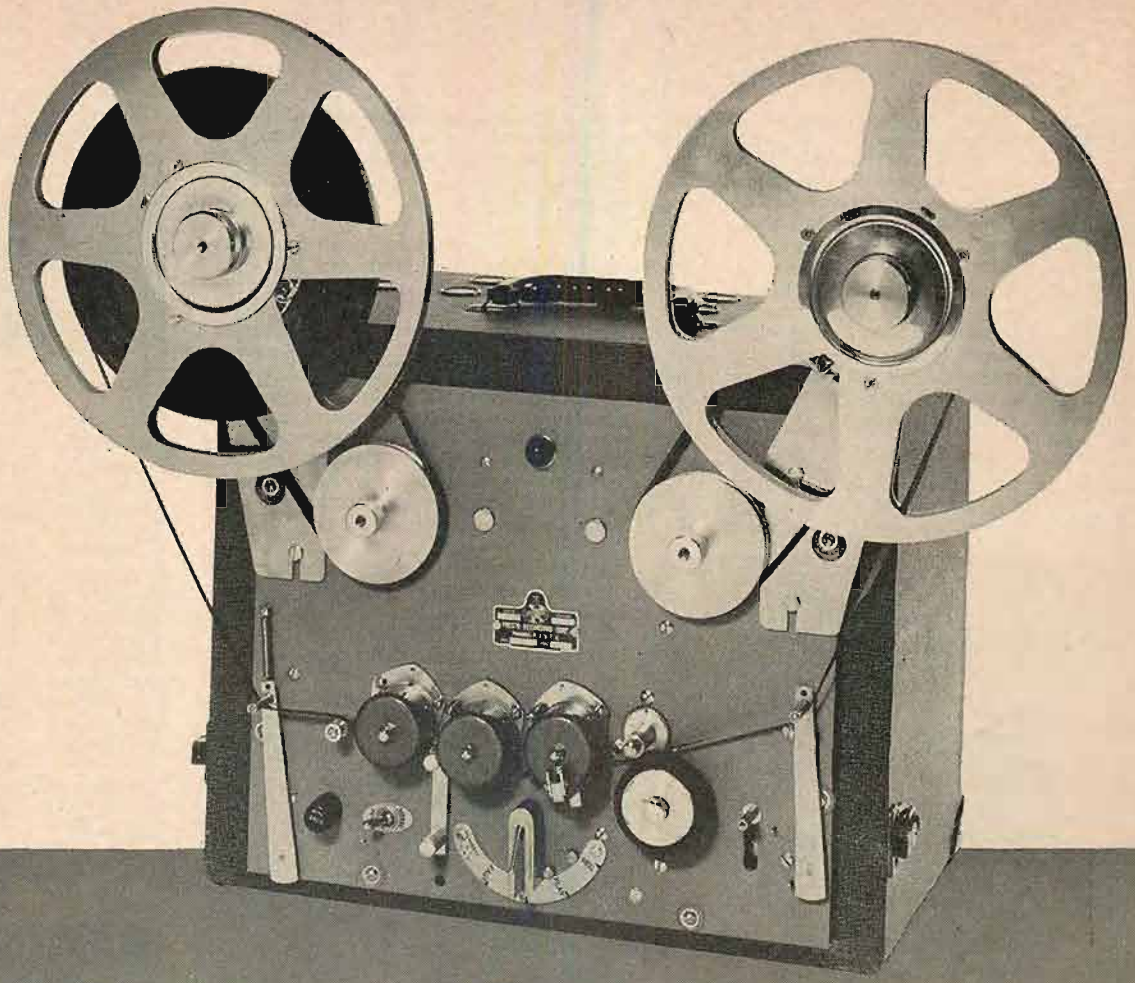
Indicative of the tremendous expansion which is taking place in the tape-recorder field were the new Crestwood recorders displayed by **Daystrom Electric Corporation.** Designed essentially for home use, the



Crestwood 401 approaches professional standards in many respects. It is a low-level-output recorder for which Crestwood manufactures a companion power amplifier. The two units are supplied in handsome luggage-type carrying cases for portability.

Officials of **Conrac, Inc.**, travelled all the way from California to present the Fleetwood line of television receivers which are specially designed with high-quality audio output for feeding high-fidelity music systems. Particular attention was accorded Models 600 and 700, both of which are equipped with a remote-control unit which may be located as much as 100 feet from the picture chassis.

you don't buy one of these every day!



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Compare these RC-7 features:

- Instantaneous speed accuracy
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- Three-motor drive
- No friction clutch or friction brakes
- Heavy duty construction throughout
- Separate-erase-recording-playback heads
- Twin speed: 7½"/sec. or 15"/sec.
- Frequency response to 15,000 cps.
- Reel size: to 10½" (with RA-1 adapter)

Purchase of a tape recorder is a major investment. And, with so many unproven brands on the market, it simply does not pay to select anything but a recognized, precision built and proven recorder.

The PRESTO RC-7 is just such a unit. Designed and manufactured by the world's foremost producer of precision recording equipment, the RC-7 with RA-1 reel adapter is today's No. 1 buy in fine tape recorders. Here is a unit that is fully portable for field recording, yet with the rugged construction and precision operation characteristic of the finest studio equipment.

If you're planning to replace an existing unit or add an additional tape recorder, your selection of a PRESTO RC-7 will pay long term dividends in faultless service, ease of operation and the genuine satisfaction of owning the best.

Do you own a Presto RC-7? The RA-1 adapter will allow you to use reels up to 10½" diameter. Write for full details and price.

PRESTO RECORDING CORPORATION

PARAMUS, NEW JERSEY

Export Division: 25 Warren Street, New York 7, N. Y.
Canadian Division: Walter P. Downs, Ltd., Dominion Square Bldg., Montreal

WORLD'S LARGEST MANUFACTURER OF PRECISION RECORDING EQUIPMENT AND DISCS

It seems to be a pleasant habit of **Cook Laboratories, Inc.**, to present each Audio Fair with a fabulous example of recorded sound. This year was no exception. Using a battery of 20 specially-designed speakers fed from one of his company's binaural recordings of a large pipe organ, Emory Cook, president, thrilled thousands of visitors with startling reproduction of a 16-cycle note—fundamental, that is. Those who could remove their attention from the remarkable demonstration of sound were treated to a preview of the first working model of a new changer arm which mounts two pickups for binaural records.

DuKane Corporation rigged up a 'scope to illustrate the recording and playback frequency response of the new Tru-Fidelity tape recorder. Clearly shown was the

unit's ability to handle 20 to 12,000 cps at 7½ ips. Available in both panel-mounting and portable models, the Tru-Fidelity recorder operates at 3¾ and 7½ ips, and is a masterpiece of industrial design.

Long known principally for the excellence of the jewelled styli manufactured by the company, **Duotone** chose its Fair exhibit to announce that it is now handling American distribution for the Holland-made Philips line of loudspeakers. As in previous Fairs, the focal point of the Duotone suite was an excellent display which dramatized the superiority of the diamond over other stylus materials for hi-fi music systems.

Espey Manufacturing Co., Inc., a first-time participant in the Audio Fair, displayed a greatly expanded line of tuners and amplifiers, including a new binaural unit which was featured in demonstration. Of particular interest to dealers who were present was an Espey-designed demonstration stand, which contains one each of the various Espey models and incorporates a switching arrangement for playing any desired tuner and/or amplifier.

As in years gone by, **Electro-Voice, Inc.**, came through with one of the Fair's truly outstanding exhibits of fine audio equipment. Sharing honors with the handsome Georgian 4-way speaker system were E-V's new ultra-linear ceramic cartridge and Model 15-TRX triaxial reproducer. Repeating another aspect of former E-V exhibits, program material used for demonstration was exceedingly well chosen.

Fairchild Recording Equipment Corporation, which has long been among the leaders in the manufacture of professional disc and tape recorders, used its Fair exhibit to emphasize its penetration into the consumer market for high-quality audio equipment. Along with the Model 215 magnetic pickup which was first shown publicly at the 1952 Fair, the exhibit featured two new Fairchild developments—a plug-in tone arm which accepts all standard cartridges, and a preamplifier-equalizer which is exceptional both in appearance and performance. Both of these items are certain to create a stir when they strike the audio market place; first deliveries to dealers are scheduled for around December 30.

A new ribbon-type pickup, designed by D. T. N. Williamson of Williamson amplifier fame, was given its first American showing by **Ferranti Electric, Inc.** Known as the Ferranti pickup, the new unit features an integrated design of arm and head, with an extremely low mass movement, and exceptional compliance. The unit was demonstrated tracking perfectly a 20-kc cut on lacquer at 1-inch concentricity at 78 rpm. Response is uniform from 20 to 20,000 cps.

Avery Fisher and James Parks, president and sales manager, respectively, of **Fisher Radio Corporation** were on hand to give official sanction to the first public introduction of several new Fisher entries in the high-fidelity market place. Particularly out-

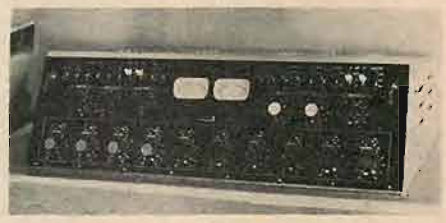
standing was the new Model 70-RT AM-FM tuner, which includes built-in preamp-equalizer, with tone controls. Beyond all question, the 70-RT satisfies the need for a precision tuner which includes within a single chassis all the control facilities required for a high quality music system.

A deluxe addition to the well-known Garrard line of record changers and single players was given its first public showing by **Garrard Sales Corporation.** The new RC-90 changer permits variable speed control at all operating speeds, along with a number of other features including a manual play position and easy adjustment of tone arm pressure. A noise suppressor across the a.c. switch eliminates the "clunk" which is usually heard in the speaker when a changer is shut off. Shown with the new RC-90 was the standard RC-80 changer upon which Garrard has built its enviable reputation.

Visitors to the exhibit of **Gately Development Laboratory** were treated to the first public showing of the "Purest," a newly-developed folded-horn enclosure which does not require corner location. Performance of the Purest, also of the original Gately Super-Horn corner-type enclosure, was entirely satisfying.

General Electric Company, whose development of the GE magnetic cartridge played no small part in bringing the country's music lovers face-to-face with the wonders of high fidelity, has broadened its coverage of the industry to include a new remote-control amplifier, a wide-range coaxial speaker, and a record compensator. The latter item, for connection between pickup and amplifier input, is designed to bring up-to-date existing music systems which are not equipped with record equalization.

Strictly professional in character, the **Gates Radio Company** display presented the firm's new CC1 master control console



which represents many innovations in technical design. Flexibility of control afforded by the CC1 is creating wide acceptance for the unit throughout the broadcast and recording industries.

Dictating equipment shared honors with transcription arms, equalizers, and a host of other audio components in the exhibit of **Gray Research & Development Company.** Although the bulk of its activity these days is devoted to the manufacture of studio equipment for TV stations, Gray is still deeply involved in audio as was evidenced by a display which was thoroughly entertaining.

Among the more impressive complete high-fidelity music systems shown at the Fair was the Model 1621 console introduced by **The Hallicrafters Company.** Enclosed in a handsomely-styled cabinet, the

unit comprises a Hallicrafters AM-FM tuner and matching amplifier, Garrard three-speed record changer, two Jensen speakers, and the Hallicrafters studio record adjuster. Especially noticeable was the fact that ample cabinet space has been allowed for speaker housing.

H. A. Hartley, president of the English company bearing his name, in his third Audio Fair appearance found his time equally divided between acknowledging the welcome of his many American friends, and demonstrating his firm's new 20-watt amplifier, together with a new tape recorder produced by his company in collaboration with another English firm, **Wright and Weaire, Ltd.** It goes without saying, however, that the Hartley Model 215 speaker and Boffle were his primary interest. According to Mr. Hartley, "The particular object of our exhibit this year was to show that in pinning our faith to the single-unit speaker to cover all frequencies we could still provide really impressive bass in large rooms."

Harvey-Wells Electronics, Inc., long known for the manufacture of communications equipment, made an auspicious

(*Continued on page 63*)

the unique Regency

KLIPSCH LICENSED FOLDED HORN ENCLOSURE

with complementary speaker systems

Provides "built-in" corner; can be used in corner or against flat wall

Designed for 15" coaxial speakers, or separate 2-way and 3-way systems . . . without need for modification

One full octave of added bass guaranteed over any commercially available bass reflex enclosure

10 to 15 db more efficient than conventional enclosures; laboratory flatness ±5 db to 30 cps

Dimensions:
high
33½" wide
19" deep

REGENCY ENCLOSURE ONLY

Mahogany. List $200.00; Audiophile Net, $120.00
Blonde. List $215.00; Audiophile Net, $129.00

COMPLETE REPRODUCER SYSTEMS

REGENCY II. Includes E-V Model 114-A 2-way system in Regency enclosure.
Mahogany. List $517.00; Audiophile Net, $310.20
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Superlatively styled in low-boy motif, gracefully accented by a solid antique brushed brass grille, the Regency is appealing as a design of excellence and enduring beauty. Adaptable to the living room, study or den, the exquisite veneers are hand-rubbed to a mirror finish on every exposed surface. The Regency is available in rich mahogany or smart lustrous Korina blonde.

A Klipsch-licensed folded corner horn with integrally built-in "corner," the Regency can be employed in the corner for augmented bass response or against the wall of the room away from the corner for flat response (±5 db to 30 cps). In the Regency, the vital cavity behind the cone baffle exploits the unique, patented Klipsch feature of resonating the back-load with the frontal air load to increase bass efficiency through a broad 4-octave pass-band acoustic circuit.

Send for Bulletin 185

Electro-Voice

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Handbook of Sound Reproduction

EDGAR M. VILLCHUR*

Chapter 15, Part 1. Power Supplies, Hum and Noise

AN AUDIO AMPLIFIER must control an independent source of energy in order to amplify, and for its operative needs must also use up power that does not get passed on. The a.c. power receptacle is the most common source of this energy, but the electric power supplied commercially must be changed in form before it can be used. The circuit that performs the necessary conversions is called the power supply.

The alternations of the a.c. line make power transmission and distribution more convenient, and make it possible to employ step-up and step-down transformers in the amplifier. The common value of 117 volts (in the U.S.) is, similarly, a convenient one. However the alternations have no direct use in the vacuum-tube circuit itself, and the voltages required by the amplifier stages differ in value from 117 volts. The power supply must therefore step the voltage down for tube heaters, and perform the operations of voltage step-up, rectification, and filtering for the plates and screen grids.

Unfortunately the alternations always get into the signal channel to a greater or lesser degree, creating hum output at the fundamental and harmonic line frequencies. In addition the power supply intrudes its own characteristics into the picture, limiting the amount of power that can be drawn by the load, disturbing the essentially constant-voltage nature of the line source, or serving as an inadvertent path for low-frequency positive feedback between stages. A properly designed power supply reduces all of these effects to such proportions that there is no significant effect on amplifier operation.

Power Supply Design

A typical audio amplifier power supply is illustrated in *Fig.* 15—1, labelled with voltages common to such application. The dual diode tube acts as a full-wave rectifier, conducting during both halves of the power cycle. Since each plate is alternately positive for each half-cycle, electrons can flow from the cathode to one or the other of the plates during both cycle halves, as illustrated in *Fig.* 15—2.

The resultant rectified voltage has a fundamental frequency double that of the input—a 60-cps a.c. line produces a rectified output of 120-cps pulsating d.c. —and this fact works to our advantage by making the task of smoothing out the pulsations easier. The shunt capacitive reactances of the filter capacitors are halved, and the series inductive reactance of the choke is doubled for the same values of capacitance and inductance, which gives us a more effective filter or, for the same effectiveness, a smaller one. Where the size and weight of the power supply components are critical, as in aircraft equipment, a primary supply frequency of 400 cps or higher is used in order to reduce the requirements imposed on the filter.

The power amplifier stage uses the major part of the total B current, and is relatively insensitive to ripple. It is fed from the supply point indicated in *Fig.* 15—1, because the low d.c. resistance of the choke enables this component to carry a large amount of current without introducing too great a voltage drop, and because the power amplifier does not need the added filtering of the R-C sections. (In some cases the screen grids may require added filtering.) A comparable number of milliamperes flowing in the filter series resistors, besides requiring resistors of high wattage, would introduce a totally unreasonable voltage drop. It is thus desirable to use a choke with the lowest possible d.c. resistance; any changes in load current associated with signal variations will not then involve a significant change of d.c. voltage drop across the choke, and hence will have little effect on the B+ voltage.

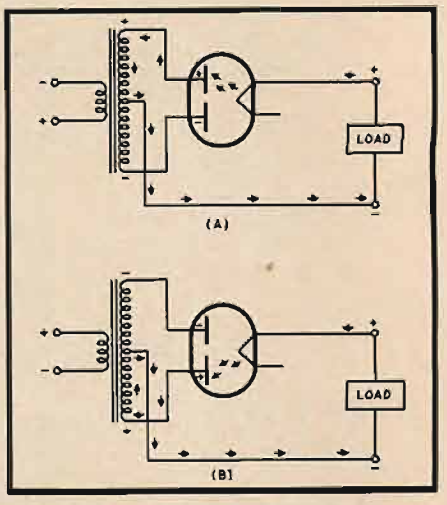

Fig. 15—2. Operation of a full-wave rectifier. Each half of the tube conducts alternately.

Voltage Regulation

The voltage regulation of the B power supply refers to its constancy of voltage under changing load. A straight Class A amplifier draws the same amount of current at all times, but class AB amplifiers draw more current at large signal amplitudes. If the B supply voltage goes down significantly on signal peaks the amplifying characteristics of the tubes will be instantaneously changed and distortion introduced. This is particularly true of Class B amplifiers, and in some cases gas-filled voltage regulator tubes have been employed to keep the voltage constant despite changes of either load current or line voltage. It is possible to

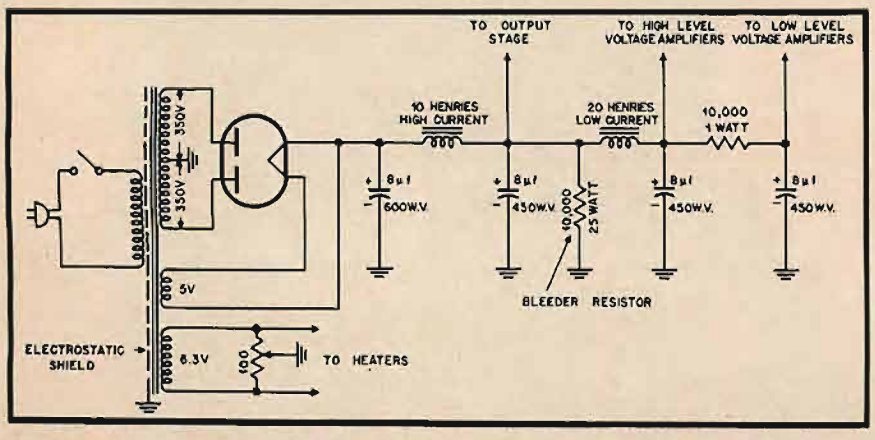

Fig. 15—1. Typical power supply for an audio amplifier. The high voltage winding of the transformer is rated as 700 v c.t., or as 350-0-350. The bleeder resistor is not required if the output stage is in Class A.

** Contributing Editor,* AUDIO ENGINEERING.

SPECIALIZATION
MAKES THE DIFFERENCE

Specialization may be defined as the concentration of all effort to a special or specific course of action

Even a mechanical device concerned with the function of record reproduction should possess all the advantages of such specialization.

Most units undertake to do much more. They change records, mix records, flip records, reject records, and assume a multitude of other functions. This is 'generalization' as distinguished from 'specialization'.

The REK-O-KUT turntable, on the other hand, is devoted entirely to playing records. And every design feature, every fragment of engineering know-how has been devoted and restricted to the all-important job of playing records... to provide the constant, steady, unwavering record motion necessary for the faithful reproduction of records free of mechanical distortion.

Specialization makes that difference. And all of the efforts and facilities of the manufacturer shall continue to be intensively devoted to that one objective... that one aim: ***To make the finest turntables in the world.***

There is a REK-O-KUT Turntable for your specific discriminating requirement. Seven models are available at prices ranging from $59.50. At Leading Radio Parts Distributors and at Sound and Music Dealers.

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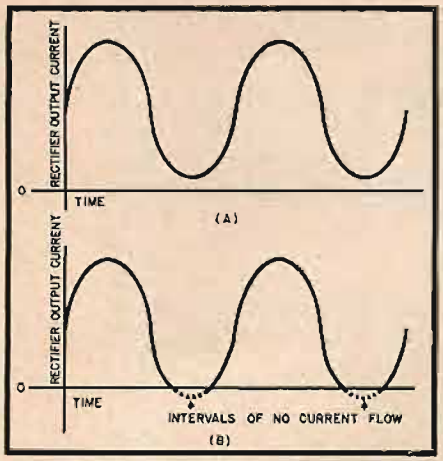

Fig. 15—3. (A) Full-wave rectifier output current. (B) Rectifier current with insufficient load. The discontinuities create an increase in output voltage. This can be avoided by the use of a bleeder resistor, which increases the minimum value of the current.

secure sufficiently good regulation without going to such lengths, however, and voltage regulators are in general reserved for other, more critical applications. The use of a well-regulated power transformer conservatively rated as to current capability, of a rectifier tube with good regulation, and of a low-resistance choke is normally sufficient.

Rectifier tubes present a resistance in series with the line which causes the output voltage to vary inversely with the amount of current drawn. Where regulation is important because of anticipated changes of current flow, the regulation characteristics of the rectifier tube, as described by tube manuals, should be taken into consideration. The voltage *vs.* load characteristics of several rectifier tubes are listed in Table 15—1.

The filter shown in *Fig.* 15—1 is of the capacitor-input type. When the first capacitor is eliminated the circuit becomes a choke-input filter. The latter has lower output voltage (the voltage of the capacitor input filter is usually at some value between the r.m.s. and peak values of the input a.c. voltage to the rectifier) and greatly reduced effectiveness as a filter, but better voltage regulation. It is not usually considered necessary to accept the first two results as payment for the last.

The "bleeder" resistor across the B supply line is for the purpose of improving regulation when there is a danger of load current dropping to low values. It has only a minor effect on the total percentage of current change, but it prevents the current from dropping below a certain minimum point. This minimum is that value of d.c. load current which falls below the negative peak of the variable component. If the d.c. flow did fall below this point discontinuities would be introduced into the wave form, as illustrated in *Fig.* 15—3. Such a discontinuity represents a sudden break in the rate of change of the current, and is like introducing an additional voltage in series with the choke,[1] causing the total voltage output of the filter to increase. A power supply serving a variable load usually has a bleeder resistor connected as shown, of a value equal to about 1100 ohms per henry of choke inductance.

Ratings of Power Supply Components

Components of power supplies are rated for given voltages and specified maximum load currents. If these ratings do not meet the requirements of the amplifier the results may be improper operation, failure in service, or both.

Filter capacitors must have a working voltage rating with a comfortable margin of safety over the voltage at the rectifier cathode. Current is not drawn from the rectifier until the cathodes of the working tubes have warmed up. Since the latter are usually indirectly heated they are only beginning to draw current when the directly-heated rectifier has already become operative. The voltage across the filter capacitors (and especially across the first one) is thus reduced very little by voltage drops in the power transformer or the rectifier tube, and may be significantly higher than normal during the warm-up period.

Transformers and chokes that are made to carry more current than they are designed for exhibit several effects: they overheat and in time may fail, and they cause the available voltage to vary unduly with change of load. Furthermore the inductance rating of a choke is in terms of a maximum current flow, and if this maximum current is exceeded the electrical inductance is correspondingly reduced due to core saturation.

Power Supply Filtering and De-coupling

As the amount of amplification ahead of a stage is increased the percentage of ripple that can be tolerated in the B supply is reduced. It is a lot simpler and cheaper to improve the filtering for such low-level stages separately, rather than to filter the entire B supply so well that the point from which the output stage derives its power is also suitable for the rest of the amplifier. But there is another factor, over and above considerations of hum, that makes separate filter sections necessary in any case. This is the danger of regenerative interstage coupling through the power supply.

[1] L. B. Arguimbau, *"Vacuum-Tube Circuits."* New York: John Wiley and Sons, Inc., 1948, p. 40.

TABLE 15—1

VOLTAGE REGULATION CHARACTERISTICS OF COMMON RECTIFIER TUBES

Tube Type	Approximate change in output voltage associated with change from half-load to full-load current*	
	Capacitor-input filter	Choke-input filter
5T4	50 v	15 v
5U4	80 v	20 v
5V4	40 v	10 v
5Y3	40 v	25 v

* At specified input voltage

Consider the three cascaded amplifier stages in (A) of *Fig.* 15—4. The output signal voltage coupled from one stage to the next is that between plate and ground. While this voltage is almost equal to the voltage across the plate resistor at signal frequencies (B+ being considered as signal ground due to the effective short of the high capacitance filters), the reactance of the filter capacitors becomes large enough to be significant at very low frequencies, and the above is no longer true. The impedance between B+ and B– then forms part of the load impedance of each of the stages, and this added element of load impedance is common to all three. Part of the output voltage of the second and third stages is thus coupled back to previous points in the signal channel.

For any two adjacent stages the feedback is negative—a fraction of the output signal of the higher level stage is effectively fed back to its own input, where the signal, ignoring phase shift, is exactly opposite in phase. But the feedback between the first and third stages is positive. The input signal to the first stage has suffered two phase reversals, and the output of the third stage has the same phase as the output of the first stage. When the amount of feedback is great enough, which is to say when the frequency is low enough for the filter reactance to have become sufficiently high, regeneration and self-sustaining oscillation occur. The subsonic frequency of this type of oscillation has given it the name of motorboating, and

[*Continued on page 57*]

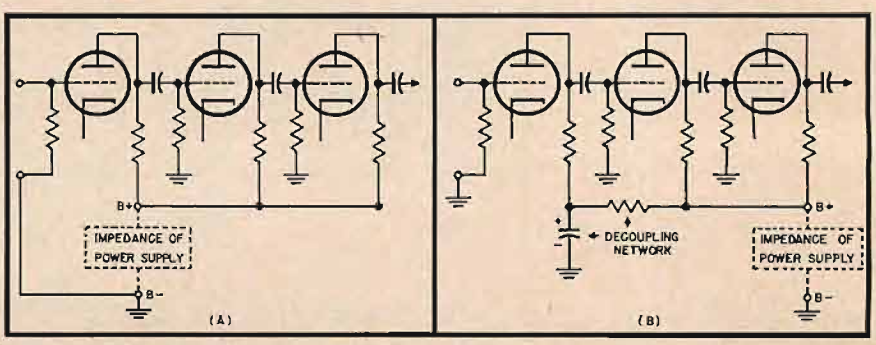

Fig. 15—4. (A) Feedback between stages due to common power supply impedance. (B) Avoidance of regenerative feedback through the power supply, by the insertion of a de-coupling network.

Audio ETC

EDWARD TATNALL CANBY*

NO, IT WASN'T *directly* my idea, the new title of this newly severed section of what for all these years (since May, 1947) has been part of the RECORD REVUE; but I'll admit that I've long had a secret yen to make use of those initials of mine in some "practical" way! Best idea previous to this—a license plate for my car. (Connecticut, where initials may be used.) Haven't been able to swing that one yet and I'm still an anonymous YV-493. So the editor's brilliant brainstorm, quite independent of me, is welcomed and you can send in all the cat-calls you want, we don't care. That "ETC" is going to have to cover a lot, as has the old title in the past. But no more, perhaps, than our own favorite HI-FI, which is pretty soon going to cover *everything* as far as I can see.

* * *

Herewith an experimental report on a fine collection of gadget equipment for phonophiles that has been sitting about my place, waiting to be noticed. I'd better say quick-like that this new department, while it will surely comment now and then on equipment of one sort or another, is not and cannot set itself up as an official Equipment Report. That sort of thing will be handled elsewhere and in a wholly different manner. What I can contribute here, occasionally, is the Amateur's Reaction—the sort of thing that happens to a non-engineer phonophile when the gadgets designed for him actually turn up in his home and are put hopefully to work. I haven't got a reputation as Audio's Number One Amateur for nothing. When I get going, I have a heavy hand. If any machine is subject to breakage, mis-use, wrong connections and the like, I find it remarkably easy to oblige with the man power. If instructions are, as Li'l Abner says, confoosin', I'm ready to get confused to the point of utter confoundedness. I qualify very nicely, I think, as Audio's Road Test, or as an audiomatic General Motors Proving Ground.

The difference between me and a million other lethally equipped amateurs, however, is that I have a strange way of stopping afterwards and analyzing. Now why did *that* happen? Also, I write my ideas down and publish 'em, which I am, fortunately in a position to do. And so, I venture to suggest, my reactions to the stuff may just possibly be *con*structive in the end, if *des*tructive at the beginning!

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

Gadget Collection

It's with that spirit in mind that I tackle today's batch of home gadgets. And I'll add this. Most new gadgets that get to the market are designed, by some enterprising person, to Fill a Need, to Rectify a Situation, to Do Something Better that hasn't been done very well. There's always a minus value in the background, somewhere.

Most gadgets are thus brave attempts to solve basically insoluble problems-of-the-moment. Few of them are perfection; there wouldn't be any need for them if perfection were possible. And so very few gadgets go all the way; almost all of them have disadvantages. Don't be surprised, then, if I mention the disadvantages. They're inherent in the breed, and let's praise those who defy the drawbacks and go right ahead with their gadgets anyhow for what they're honestly worth, the plus with the minus—the following included.

* * *

My collection is as follows—and the batch of them are cousins, inter-related. *Discs:* The Dubbings company's two test LP's, D-100 and D-101; Audax's Stylus-Disc, for testing stylus wear. *Measurements:* A neat little 50-power Japanese "Vista" microscope, to complement the Audax disc; the Weathers Stylus Pressure Gauge; the Dubbings D-500 Test Level Indicator. *Record Treatment:* Duotone Electro-Wipe Magic Record Cloth; the Walco Foam-Disc turntable covers. Let's take a look at these latter first.

Record Savers

The Foam-Disc, distributed by Walco, of Walco stylus and Stati-Clean fame, is a turntable mat made of poured foam rubber (not ordinary foam), dressed up in nice colors, in manual table models covered with smooth suede. About an eighth of an inch thick and very good looking, especially in bright red and green.

To tell the truth I was a bit baffled by these, since normally I don't go for bright decoration, for its own sake. But Walco claims utility—a soft base for dropping records and for accidental pickup falls, a firm adhesion with minimum grittiness (much better than grit-collecting flock, I agree) and in particular a magnetic separation between steel turnables and magnetic cartridges that reduces objectionable magnetic "pull." Sounds reasonable and I like the squishy feeling of the stuff. The suede model, incidentally, is excellent for disc-jockey style slipping (allowing table to spin while holding a record on cue), a major interest of mine in radio program making. DJ's note, if you've had trouble with rubber covered tables.

I'd expect a changer's capacity record load to be reduced by two or three discs by the foam mat. Not overly important, in view of the above advantages.

The Duotone Magic Record Cloth is as magic as most gadgets using that overworked term—i.e. not at all; but it works. Don't know what the impregnation is in the soft folds of felt-like cloth, but it's somewhat sticky and greasy to the feel and comes off rather too much, if your wiping away of the static is vigorous. The static goes, definitely, and so does dust and grit. But I wonder what happens (a) when the cloth becomes grit enfouled, even a bit and (b) when it is left out of the plastic casing, to dry? I haven't had it long enough to know—but I do find myself using it, and the job is simpler than with the assorted spray techniques for record treatment.

The Not-So-Eternal Stylus

Needles, needles! Now that our diamond-bearing friends have done such a fine job in publicizing the quick wear of metal and sapphire points, people are getting almost neurotic about their styli, and I among them. It's not so easy to tell just when a point is shot, especially when you get to listening for distortion so hard that you forget to hear the music.

I've tried a number of pocket magnifiers of one sort or another on stylus points with very little satisfaction, as far as judging the condition of a 1-mil point is concerned. It's either not magnified enough, or with a higher blow-up, the focusing problem is hopeless; nobody has steady enough hands. Only a real microscope, and that specially adapted, will ordinarily give those fine, jagged images of worn-down tips that we've all seen in the ads of late.

The "Vista" 50-power pocket glass from Japan, is the size of a sawed-off pen light and as convenient, but its special feature is a brilliantly simple solution to the problem of focus. The business end of the tube is sliced off diagonally: the slanted ellipse, with a hole in the middle for the objective, is slightly concave and chromed so that it is a reflector to spot light on the point of focus. Neat. In order to find that focus you merely rest the lower end on the surface to

[*Continued on page 59*]

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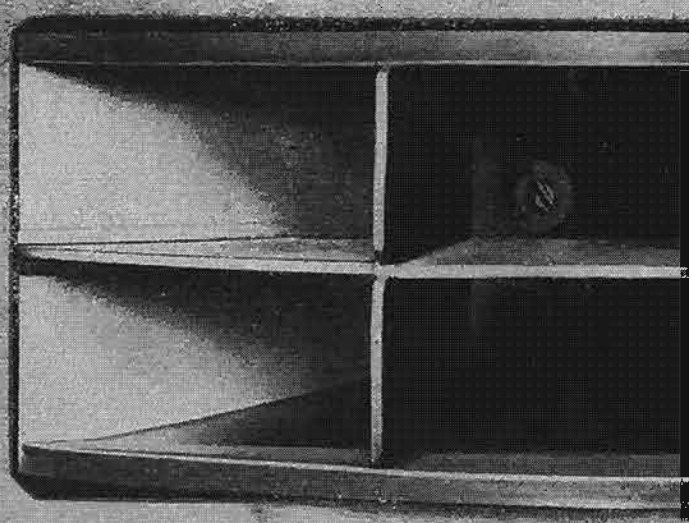

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EDWARD TATNALL CANBY*

MORE SPOKEN WORDS

Shakespeare: Romeo and Juliet. Old Vic Company. (Claire Bloom, Alan Badel).

RCA Victor LM 6110 (3)

Complementing the recent Macbeth from the Old Vic is this more imposing album, a further step in the modernization of Shakespeare and (strangely enough) the return, via records, to the dependence on imagination for scenery that actually characterized the original Shakespeare productions. The plain theatres of Shakespeare's day, the modern-dress (as of then) costumes, the elementary stage and sound effects, left virtually everything to the playwright and to his words, written for his speaking characters. The amazing versatility of the Elizabethan playwright in the straight use of words unadorned to build up a drama never came through more nicely than here, in Romeo and Juliet!

True, one must cope with and get used to the special and exaggerated Shakespearian way of acting, as it now exists in a tradition that is as rigid, outwardly, as that of our own fine soap dramas on the radio. For awhile, the unfamiliar grammar, the strange words, the mouthfilling phrases, will get you down. But the Old Vic knows its stuff. After awhile the conventions of this special and very great kind of drama begin to adjust themselves to you, so to speak, and the sense comes through. Conventions, mind you, that are now less rigid, no less artificial than those of soap opera, where every voice is a type, every sentence, every inflection is done just so, by actors who study and mimic until a hundred radio voices sound exactly like one another. Shakespeare has the same conventions—but of different sorts, and his, one begins to realize, allow for a lot bigger scope in the drama than the soap drama. Both (never forget), being drama are essentially artificial and utterly unlike nature—though the more dramatic for it.

And so Shakespeare's extraordinary preoccupation with death and dying is the more vividly and absorbingly clear here because of such unlikely and improbable monologues as those of Romeo and of Juliet, dying or about to die—and the plain fact that the Old Vic actors know this convention for what it is, and exploit it with the utmost finesse. Drama on records has never quite equalled this album before.

Hi-Fi, definitely, with the simplest of sound-effects, unobtrusive musical curtains, slight changes in liveness to indicate small or large places, the usual formalized "mob sounds" for parties, crowd scenes, discovery-of-the-dead-lovers, etc. It's extraordinary how little is needed to back Shakespeare up—as he intended it should be. Not even the slightest direct indication of who is whom or where is where—it all comes out, expertly devised by Shakespeare, in the course of the actual words. Better grab this album fast, and play it often.

Columbia Masterworks Literary Series. Prose readings by famous authors. **Columbia SL-190 (12).** (Special album, but probably available soon separately.)

Here is another revolution from Columbia—not so much in the mere mechanics of recording a batch of voices, which is hardly revolutionary now with five years of tape already behind us, but rather in the new and exciting understanding of the LP medium itself that this shows.

The series is not yet focussed in intent. There seem to be two aims here, one, to record "documentary" readings of works by their own authors, to a length and continuity never before attempted, and, second, to record spoken stories—as stories. My impression is that the first aim is uppermost, the documentary; I am convinced that the second—wonderfully exploited in a few of the records—is by far the more important.

At this point I'm only halfway through the batch, having covered readings by Somerset Maugham, Steinbeck, Saroyan, Sir Osbert Sitwell and Edna Ferber. I still have Edith Sitwell (of the famous "Façade" recordings where she reads her own texts to Walton's music), Truman Capote, Aldous Huxley, John Collier, Sacheverell Sitwell (third sibling of the famous family) Katharine Anne Porter and Christopher Isherwood—phew! Each of them has an entire 12-inch LP, approaching a solid hour of reading. Enough to keep me and anyone else busy for a good month, without a single musical record. The non-story discs are interesting, no doubt, and instructive and documentary. But what gets me are the stories. For stories, just keep in mind, were originally and timelessly meant to be told—out loud. It's only us moderns who have the new-fangled idea that a story should be read.

And so—out of the batch, so far, I recommend as a great experience two discs, Edna Ferber reading and acting her long short story, "The Gay Dog," about a pathetic hen-pecked Chicago bachelor, and Somerset Maugham's two stories, "The Fat Women of Antibes"—which is absolutely superb entertainment—and a somewhat lesser value on the obverse, concerning a circus-act lady who dives into a six-foot tank of water flaming with gasoline, two shows every evening. (Nope, she doesn't miss—not in the story. Maugham's too clever for that.) John Steinbeck's two stories are both crackerjack ones, but he's no reader and you can follow them in suspense thanks to their own sheer power, not to his anti-climactic reading. Saroyan is unintelligible as he "tries" (so says the label) to read his own work. He insisted on using his own tape recorder and I'd hate to have to mention the brand; luckily I don't know. It st.....ks.

I'll report on the others when I get 'em played over. I've heard good things about the Truman Capote "Children on Their Birthdays"—two entire sides long. Might try it too. I'm all for more stories on records—complete and long—by real story tellers, of every sort. How about folk stories? They're always told out loud, except when people "collect" them for books.

Stravinsky: Oedipus Rex. Text written and spoken by Jean Cocteau. Cologne Radio Symphony and Chorus. **Columbia ML 4644**

Le Petit Monde de Don Camillo. (Sound track) Fernandel and others.

Decca DL 7024

Here are two records indicating among other things what vast new areas LP has been entering. A large number of musical works which in their original form included some species of speech—narrator, operatic dialogue, even straight drama to which had been added incidental music—now suddenly can appear in unexpected wholeness via the new medium of LP; where formerly the speech parts were universally scrapped in recording as quite impractical, now we've discovered that speech adds mightily to the effectiveness of an LP, as well as allowing for a more complete presentation. Especially hi-fi speech, undistorted, with "presence" and life, and with lots of sibilants.

Oedipus Rex is an odd piece, composed to a synthetic Latin text that was translated—into Latin, not out of it—from a Cocteau original out of Sophocles. The narrator's role in the score is supposed to be spoken in the language of the audience, wherever the piece is done. In this case, however, Stravinsky has got the author himself of the original, and so the narration is done in Cocteau's own French, though the Latin parts are translations from Cocteau!

French, you'll find, is a remarkably effective language on records, undoubtedly because it is liquid, relatively unpercussive, depending on quantities—syllable lengths—instead of accent, which is very nearly equal in every syllable. Ideal for the mike, which objects to percussions and all sudden changes of dynamic level, as every radio speaker must learn.

Technical note: the performance of Oedipus was taped in Cologne, Germany, but Cocteau's voice was taped at a French performance some eight months later.

* * *

Le Petit Monde (The Little World of Don Camillo) is nothing more than the straight sound track (or excerpts?) of the film itself, in French, and the remarkable thing is its mere existence in this form—for Decca has released it without any adornment whatsoever, not even notes on the album cover, nor any translation, synopsis, blurb, or what have you. Even the labels, made in U.S.A., are in French. Obviously Decca must take for granted that any buyer of this record knows his French by heart, which only goes to show how "esoteric" an LP can be these days and still sport a big, popular label like Decca.

The original seems of high quality—could it have been taped, rather than made on sound film?

Beethoven: Music from Goethe's Egmont, op. 84. Wurttemburg State Orch., State Theatre Chorus (?) soloists, F. Leitner.

Decca DL 7540

Here's another—with words in German. Not, it is true, the entire drama, which would be somewhat impractical even with LP to put it mildly, but instead of the usual overture, so very familiar, we now have a group of eight musical numbers, instrumental and for tenor and contralto solos—and, at the end, a long and impassioned dramatic monologue by the hero himself who at its conclusion rushes forth to "die for freedom" against tyranny, in typical Beethoven (if not Goethe) style. The German is excellent and well recorded for this last band; again it gives a sense of realism and aliveness to the whole work.

Odd note: The Chorus, as mentioned in the label and also in the cover annotations, is not to be found; I haven't spotted it yet after a couple of playings. Maybe it got edited out by Decca's (right hand) engineers, without telling the production (left hand) department.

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FI

(Since all Fi is Hi these days, we might as well save a couple of pieces of type now and then.)

Full Dimensional Sound—A Study in High Fidelity. Notes by Charles Fowler.

Capitol SAL 9020

Those who have attended recent Audio Fairs will know all about this album, which was distributed to practically every exhibitor and immediately put to use. (There was also a "trade" hi-fi record with announcer, but that one is not on public sale.) An excellent job and to my knowledge the first of its type from a major record company's catalogue. The material is predominantly classical music on one side, popular on the other, but the range is greater than this implies—and only goes to show, as a matter of fact, how Hi-Fi has levelled out the old differences between those arbitrary categories. From Glazounoff to Stan Kenton, Bloch to Foghorn Boogie, this disc illustrates most of the major points of Hi-Fi sound and its interest for addicts will be as great as it is transient—what with isolated single-movement excerpts—to the music lover, popular or classical. Try the Studies in Percussion, parts 1 and 2, first. Cowbells, gongs, drums, etc.

The surfaces are exceptionally quiet (and other Capitols have been relatively noisy at times). A significant innovation is the soft plastic envelope for the record, which has enough overlap to allow a fold that is dustproof. Not practical for standard records probably (it won't fit into an ordinary record sleeve), but a step in advance nevertheless. Enthusiastic notes, at length, by Charles Fowler. No vocal explanations on the disc itself.

Scriabin: Poem of Fire; Poem of Ecstasy. Mitropoulos, N. Y. Philharmonic.

Columbia ML 4731

Scriabin: Poem of Ecstasy. Loeffler: Pagan Poem. Paris Philharmonic, Rosenthal.

Capitol P-8188

An easily described comparison between these two versions of the Scriabin piece (which, musically, is a work that makes my insides crawl, so twisted and over-wrought and out of style and taste is its post-Wagnerianism)—the two rate as Hi-Fi, one of them Columbia's by now fairly uniform high standard, the other Capitol's Full Dimensional Sound, but they represent, to my ear, two opposing mike philosophies. The Capitol may or may not be a one-mike job but its tonal color is of that type, the complex of orchestral sounds, the hundreds of submerged solo instrumental passages typical of this music blended at a considerable distance. A mellow, good sound, but not too sharply highlighted in the monaural reproduction. Columbia's, on the other hand, is less literal, less "faithful," more artificial, but in the recorded medium seems to me to bring out more of the score, to achieve more presence and aliveness. In this version, presumably with more than one mike, the solos, notably the solo violin and trumpet, are sharp, steely, etched against the total sound; not the original concert hall intention in literal terms but a good equivalent of the binaural on-the-spot impression.

Note the markedly different equalization required. Columbia has considerably more pre-emphasis that Capitol, in the highs. Be sure to adjust when making comparisons.

Borodin: Polovetsian Dances. Moussorgsky, Night on Bald Mt. R.-Korsakoff: Cap. Español. Austrian Symphony, various conductors. **Remington R-199-130**

One of those discs of pot-pourri usually unreviewable because the title is too long (hence abbreviations) or the content is too conventional. As representative of Remington's current Musirama Three-Dimensional sound it warrants notice. With this sort of opportunistic publicity (please, I ask, show me some two-dimensional sound) I have no sympathy whatsoever. Will we ever get past the -rama craze? But the record remains to be judged for itself. This one, I hasten to add, is a good one for the price though I do not know what the Austrian Symphony may be, nor whether, as is possible, it exists on other labels under more familiar but already-contracted names. The playing is good, in the final part of the Borodin unusually warm and musical. No complaints!

The sound, whatever the dimensions, is good too, though not technically up to top Hi-Fi, nor entirely ideal acoustically. The mike setting is strangely Hollywoodish, a close-to, rather dry effect, the strings only feet away. Austria? Perfectly listenable, nevertheless. Pre-emphasis is moderate, less than Columbia, there are no appreciable highs over about 8000 or so but there are enough for any musical purpose—specifically, enough to bring through faint triangles and the breath of a flute. Plenty for anyone who is interested in the music.

Surfaces, in this low-priced line, are of course substandard and may be short-wearing. The hiss of earlier Remingtons is gone, the background crackle is not objectionable. But on the Borodin side there is an interesting effect that is significant as to Musirama three-dimensional merchandizing. An odd extraneous sound, like a faint tambourine being shaken, goes all the way through and on wide range equipment is distinctly disturbing. It disappears entirely, however, with a cut-off of about 7000 cps. It will not be heard on most machines on which this record will be played. A calculated risk, a shrewd appraisal of the present situation? Possible, but it might also have been an unavoidable accident.

Wagner: Preludes to Lohengrin, Meistersinger; Overtures to Tannhaüser; Ride of the Valkyries. Detroit Symphony, Paul Paray. **Mercury MG 50021**

A sample from the recent new branching out at Detroit of the "Living Presence" technique chez Mercury. Evidently this kind of presence is not the fairly fixed sound-style that we've found consistent in London's ffrr, in Columbia's (nameless) technique, in the New Orthophonic. This Detroit disc has a sharp, very close and dead sound, brilliantly recorded, tremendously effective but very unlike some of the earlier Living Presence one-mike jobs at Chicago and Minneapolis. Not unlike the Remington disc above, strangely enough, as far as acoustics go. Interesting. Very low distortion, good surfaces. Real Hi-Fi, no doubt.

Paray (he's 70 years old) is a strange conductor and rather intriguing to hear. His Wagner tends to be on the sprightly side, French-style, in contrast to the familiar heavy German manner, and the really flighty parts—mid-section of the Tannhaüser overture (Venusberg) for instance—are as electric as cat's fur. Excellent! The Valkyries' violinistic flames crackle as you's never heard them. On the other hand, Paray has the strangest way of bouncing anything that is march-like, as though he were hoping up an down with excitement on the podium! The Meistersinger Prelude is unforgivably bouncy and staccato—missing the majesty of it altogether; the Valkyrie ladies bounce up and down too, though to better advantage. A highly individual conductor and, all in all, an attractive and unaffected musical personality. I'll look forward to more of his quirks.

Franck: Symphony in D Minor. St. Louis Symphony, Golschmann. **Capitol P-8221**

Khachaturian: Gayne Ballet. Indianapolis Symphony, Sevitsky **Capitol P-8223**

Capitol, too, is busy in the middle West; here are samples from recent additions to the FDS catalogue. The somewhat close and dead sound of these records is evidently not at all a coincidence, for the two records (and the French Scriabin disc, above) are remarkably consistent in their tonal effect. This, I'd venture to guess, is an extension of a very honorable tradition often referred to as West Coast Sound, stemming both from the big film studio sound stages and from popular recording, in which area Capitol is of course a leader. Specially built stages are—or were—more or less inevitably very dead. Film music is scarcely in need of concert hall reverberation, for music or the speaking voice. The dead, close-up technique of popular music is enormously effective with brass, percussion, and piano; but when applied to the symphony orchestra it gets hold not of these powerful elements—which are at the rear—but the strings, which are in front. Hence the over-stringy sound of many a modern classical record using close-to techniques.

I'm not extra enthused over Capitol's somewhat padded sound, but then I don't like the ultralive one-mike sensations any better. In the recorded medium, it seems to me, concert hall or no, the ideal is always between the two, with a good, round, big liveness, but also with strong, sharp highlights for the individual sounds. Can be done with many mikes and also, given the right set-up, with one.

Don't let the Capitols go by, then, without making your own decision. A lot depends, remember, on the acoustics in your listening room. It is a safe bet that Capitol records will sound terrific in a big, live listening room. For a small, padded living room, try London or the earlier and very live Mercury Living Presence discs.

Albeniz-Arbos: Iberia. Orch. des Concerts Colonne, Sebastian. **Urania URLP 7085**

Fauré: Pelléas et Mélisande; Dukas: La Péri. Orch. des Concerts Colonne, Sebastian. **Urania URLP 7097**

Urania in the past has been reissuing assorted German radio tapes—my impression being that the dates have progressed a bit faster than time has and are now almost caught up in the main, having begun with early German tapes probably from before we knew there was such a thing. I take it that Urania's "50—15,000—" trade mark now indicates its brand new records; the above are two of the kind. A sharp, glittering technique but with a good background liveness make these excellent as to Hi-Fi acoustics. The string tone is bright, well blended and not too steely, which is more than can be said of most of the discs above, all of which these surpass. Clean recording, too, and fine surfaces.

The Dukas-Fauré disc is musically unusual, the Fauré piece—a mild and attractive item, the Dukas a novelty of stunning unimportance— it has a superb array of orchestral brilliance, up to the famous Apprentice Sorcerer, but practically no content at all. Sheer, brilliantly contrived noise and as such it makes splendid Hi-Fi!

TECHNICANA

High Fidelity

An editorial on the meaning and use of the term *high fidelity* ("la haute fidélité") appears in the June, 1953 *Revue du Son*, signed by M. J. de Cadenet. It is defined as ". . . the quality possessed by an electro-acoustic chain that would give the listener the same auditory impression as if his ears had replaced the recording microphone". But M. de Cadenet concludes that technical exactitude (which would necessarily involve binaural processes) is not the complete answer. The results are judged aesthetically, and it is felt that musical standards must be involved. We have too much of a tendency to consider the quality of an electro-acoustic installation on a purely technical plan. Comparison with the original, it is concluded, must be on an "aesthetic plane," which may not yield the same results as purely physical fidelity.

This reviewer might add that if the electro-acoustic chain that is being discussed does not go beyond the recording microphone or the reproducing loudspeaker, and if such factors as the relative acoustical conditions between the concert hall and the living room, the balance of sound from the different instruments, and so on are not taken into account, there can be little to disagree with in this editorial.

Record Surface Noise

The July, 1953, issue of *Wireless World* reports on a lecture delivered by D. T. N. Williamson on "Suppressing Gramophone Surface Noise." Particular reference was made to the "impulsive" type of noise associated with dust particles attracted to plastic long-playing discs.

Analysis of a typical pulse shows that it can be distinguished from recorded program transients by the fact that its energy content above 20,000 cps or so is higher. The use of a high-pass filter with this cut-off can therefore furnish a segregated pulse-actuated signal. Such a signal is used to operate

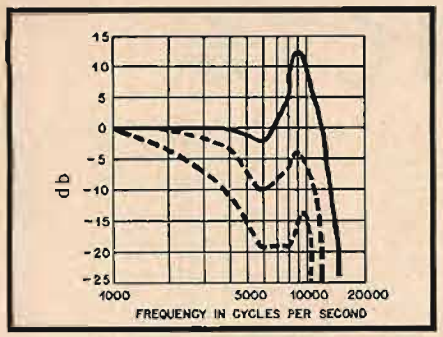


Fig. 1

a gate circuit that squelches the program —music and noise pulse both—momentarily. Mr. Williamson stated that experience has shown the ear to be tolerant of individual pulse deletions of up to 250 microseconds duration. The cumulative time taken up by the cut-off periods, however, could be as high as one tenth of the total program time.

"Clicks" were successfully removed from a specially marked record, but it is stated that some further work is required to perfect the gating circuit.

LP Record Pickups

The July, 1953, issue of *Wireless World* also carried an article by G. H. Russell, discussing "Inexpensive Pickups on Long-Playing Records." Mr. Russell points out that the increased compliance of the long-playing record material reduces the frequency of the high-frequency pickup resonances. Tests conducted with a moderately priced pickup, using an LP test record, showed a very annoying peak of about 12 db at 9,000 cps. (See *Fig.* 1) Such a peak results in a buzzing string tone ("reminiscent of a cloud of mosquitoes in flight"), in rapid cut-off as the frequency of the recorded signal is raised, and in an amplification of distortion in the recording.

A pickup whose upper resonance is above 14,000 cps is expensive, and also involves added amplification due to relatively low output. The solution to the resonance problem proposed here is the use of an anti-resonant electrical circuit, shown in (A) of *Fig.* 2. The improvement in pickup performance from the original response is evident from the graph in (B).

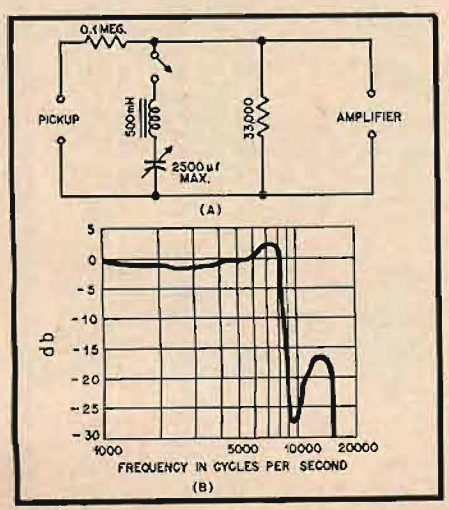


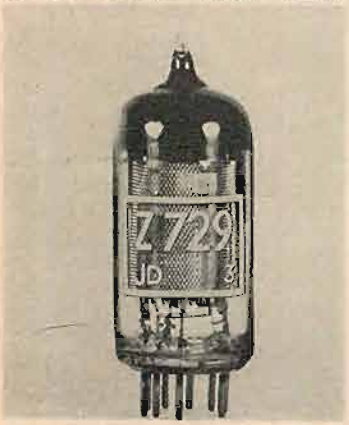
Fig. 2.

NEW PRODUCTS

• **Magnetic Amplifiers.** Remarkably high power handling capability for their size and weight characterizes a new line of miniaturized magnetic amplfiers now being manufactured by D & R, Ltd., 402 E. Gutierrez St., Santa Barbara, Calif. Special core materials, winding techniques, and mountings, coupled with the use of high-frequency a.c. power, permits

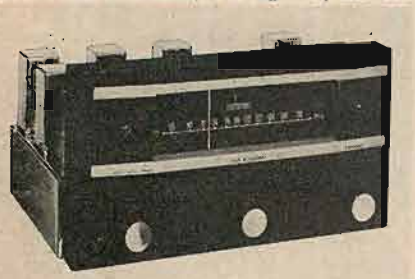
attainment of rapid response time and high power-handling capacity in units extremely small and light. The Model MA-48 illustrated weighs only three ounces, yet delivers a power output conservatively rated 25 watts.

• **High-Gain Audio Input Tube.** Amplifier manufacturers primarily will find interest in the Genelex Type Z729 pentode, a low-hum, low-noise, low-microphonic voltage-amplifying tube manufactured by General Electric Company, Ltd., of England, and marketed in this country by British Industries Corporation, 164 Duane St., New York 13, N. Y. The Z729 fits a standard 9-pin miniature socket, and has been expressly designed for use in high-gain preamplifier and equalizer stages. An internal shield completely



surrounding the elements is one of the tube's features. Data sheets giving full technical information and performance curves are available from British Industries Corporation.

• **Craftsmen FM Tuner.** Remarkable performance characteristics are embodied in the new Model C900 FM Tuner, recently introduced by The Radio Craftsmen, Inc., 4401 N. Ravenswood, Chicago 40, Ill. De-

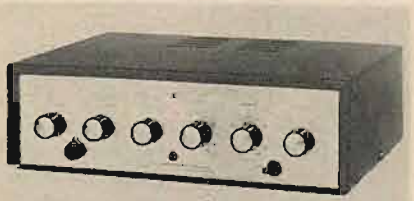


signed for unusual sensitivity, low distortion, and maximum stability, the tuner includes a number of advancements in circuitry and components. Cascode double-triode r-f amplifier affords sensitivity of 1 μv for 20 db quieting. Low regeneration and easily aligned transitionally-coupled i-f stages result in less than .05 per cent intermodulation throughout the entire circuit. Amplified AFC reduces drift 100 times. Tubes may be replaced without need for realignment. AFC action is continuously variable. Descriptive sheet available on request.

• **"Write-On" Labeling Tape.** Identification of tape recordings is made easier with "Scotch" write-on tape No. 48, recently introduced by Minnesota Mining and Manufacturing Co., St. Paul 6, Minn. Pressure sensative, the tape is supplied in a continuous roll of 40 labels which are applied directly to the sides of the reels. Printed on the white tape is "Reel

No. — Data — Subject", together with blanks for filling in the desired information. The tape is supplied with a special matte finish which can be written on with pen or pencil.

• **Scott Transcription Amplifier.** Resembling in appearance the "front end" of a conventional remote-control amplifier and but little larger in size, the new Scott Model 99-A is in reality a complete 10-watt amplifier and power supply, including preamp-equalizer and full-range controls. Treble and bass controls afford both boost and cut, and are continuously variable. An automatic loudness control is pro-



vided with means for adjusting compensation from zero to full. Selector switch permits ready choice of four inputs. Frequency response is flat from 20 to 30,000 cps. Harmonic distortion is less than 0.8 per cent and intermodulation under 0.3 per cent at 10 watts. Output tubes are balanced automatically by a self-balancing phase-inverter system. Dimensions are 13¼ x 3¾ x 9¾ ins. Desciptive bulletin will be mailed on request to Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass.

• **Bell High-Fidelity Amplifier.** Although moderate in price, the new Bell Model 2199

amplifier represents no compromise in audio characteristics or operating flexibility. Output is 12 watts at less than one per cent distortion, and frequency response is 20 to 20,000 cps ± 0.5 db. Six controls include a seven-position selector switch which provides equalization for all types of records, as well as inputs for TV, tape, and tuner. Speaker outputs have impedances of 4, 8, and 16 ohms. There is also a high-impedance output jack for feeding recorders. Volume control is compensated. Separate bass and treble controls provide both boost and droop. Removable brushed-bronze escutscheon and 1¾-in. extension shafts simplify mounting in any cabinet. Bell Sound Systems, Inc., Columbus, Ohio.

• **E-V 4-Way Speaker System.** Handsome cabinetry is combined with advanced engineering design in the Georgian, a new

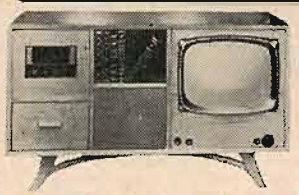
Electro-Voice multispeaker reproducer which utilizes a Klipsch "K" horn with special 15-in. driver for exceptional bass response. An electrical crossover feeds frequencies above 300 cps to a compression-type horn-loaded mid-low frequency driver with 58-in. path length. An acoustic crossover confines frequencies from 1000 to 3500 cps to a special diffraction horn. Above 3500 cps, an E-V Super Sonax very-high-frequency driver takes over to extend response beyond the upper limit of audibility. The unit is equipped with two controls, one to govern "presence", the other to control brillance. Dimensions are 52" h x 34" w x 26" d. For complete description and technical specifications write to Electro-Voice, Inc., Buchanan, Mich.

• **Low-Priced Tape Recorder.** Introduced as the lowest priced tape recorder with comparable characteristics, the new Telectrotape is a dual-track unit with operating speed of 3¾ ips. Features include fast forward and rewind, three high-impedance inputs, and recording level indicator. A

single control permits switching from record to play to idle. The unit handles spools up to 5-in. diameter, and may be operated with the cover closed. It is housed in an attractrive luggage-type carrying case and measures 7 x 10 x 11 ins. Weight is 14 lbs. Manufactured by Telectrosonic Corporation, 35–18 37th St., Long Island City 1, N. Y.

HARVEY the House of Audio

25th ANNIVERSARY YEAR



RIVER EDGE

LOWBOY Model P-1260

For TV and Hi-Fi

A sturdily constructed, handsomely finished 60-inch cabinet designed to house TV chassis and Hi-Fi components. Accommodates picture tubes up to 21-inches with 15-inch loudspeaker, and 27-inch tube with 12-inch speaker. When 15-inch speaker is used, record storage compartment, shown in illustration, is eliminated. Made with perma-bonded heavy plywood and lumber, treated with protective lacquer, and hand-rubbed. Styling is modern and matches any decor.

Model P-1260 in Cherry or Cordovan Mahogany..... **$195.00**

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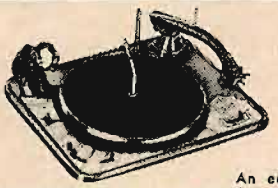
PROFESSIONAL

TAPE RECORDER

M80 Series

Provides full range response: 30 to 15,000 cycles at 7½ inches/sec., and 30 to 20,000 cycles at 15 inches/sec. Has new, slot-loading feature, and automatic tape lifter. After loading, all operations are pushbutton control. Starts and stops within 1/10 second. Accommodates 10½ inch reels. Flutter and wow are less than .1% at 15 inches/sec. Employs high quality, low noise amplifiers with direct-coupled cascade input stages. Can be adapted for remote operation.

M80-A chassis only for rack mounting..... **$1240.00**
M80-AC portable, with cases..... **1295.00**
M80-ACC console complete with cabinet..... **1345.00**



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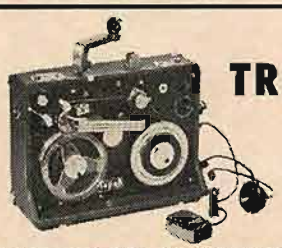
RECORD CHANGER

Model RC-90

An entirely new changer with outstanding innovations. A new type of 4-pole motor provides absolutely silent operation, and freedom from wow, waver, and rumble. Gives instant selection of speeds with all three speeds adjustable ±3 rpm. Other features include: gentle pusher platform, weighted turntable, manual position for single records, finger-lift for manual use of tone arm, muting switch, automatic shutoff, and interchangeable plug-in cartridge heads.

Model RC-90 Record Changer..... **Less cartridge $66.00**



The NEW

TRAVIS TAPAK

Portable

TAPE RECORDER

A dry-cell battery-operated tape recorder which closes up to small suitcase size: 10x14x5½ inches. The Tapak is ideally suited for on-location recording anywhere: at sea, in the air, aboard trains, in cars, or on foot. It erases, records, monitors, and has built-in editing device. Provides for fast power-rewind and instantaneous playback through single earphone headset. Drive mechanism is spring-powered. Runs 5-6 minutes on one winding. Indicates when spring has run down, and permits rewinding without interrupting recording operation. Records at 7½"/sec.

Complete with microphone, earphone, two flash cell A batteries, and 67½ v. B battery..... **$329.45**

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

REK-O-KUT

12-inch, 3-Speed TURNTABLES

Model L-743

A broadcast quality turntable designed for discriminating users . . . professionals and audiophiles. Driven by 4-pole motor. Turntable itself is made of cast aluminum, and exerts no pull on magnetic cartridges. It is precision machined with a heavy rim for dynamically balanced flywheel action.

A single knob permits instantaneous selection of any record speed: 33⅓, 45, or 78 rpm. Record slippage is eliminated through use of new mat material. There is virtually no rumble, wow or flutter. Complete with 45 rpm record adapter..... **$59.50**

Model T-12H A DeLuxe version of the above for the ultimate in turntable design for 33⅓ and 78 rpm only. Driven by constant speed hysteresis synchranous motor..... **$119.50**

The REL *Precedent* FM TUNER

Unquestionably the finest FM tuner ever made. This successor to the famous 646B incorporates every important advance developed in the art of FM reception. Sensitivity is 2 microvolts for better than 40db quieting. Frequency response is 30 to 40,000 cycles ±1db. Waveform distortion is less than .5% for 100% modulation. Provides 2-volt output to high impedance, and .2 volts to 600 ohms. Front panel includes slide-rule dial, tuning meter, signal strength meter, tuning control, radio frequency and audio gain controls, and power switch. Power supply is self-contained. Supplied complete with tubes.

Chassis only (for custom installations)..... **$325.00**
Relay Rack Model..... **335.00**
Cabinet Model (Mahogany, Walnut or Blonde)..... **360.00**

The FERRANTI RIBBON PICKUP

Designed by D. T. N. Williamson, this new pickup represents years of study and development. It is a complete unit of pickup head and arm with the head interchangeable for either standard or microgroove records.

Frequency response is uniform to 20,000 cycles with output provided to 100 kc. Only 3 grams stylus pressure. Mechanical resonance has been kept to 3 cycles, well below the recording range. Greater than normal compliance promotes uniform response and minimizes record wear. Both heads employ diamond styli with an elliptical stylus used for standard groove records. When used with appropriate transformer, output is 20 mv into 100,000 ohms.

Ferranti Pickup with arm and transformer..... **$76.95**
Specify standard or microgroove.

Extra Head (standard or microgroove)..... **37.50**

R. C. A. MICROPHONES

Broadcast quality units of tested and proven performance ideal for on-the-air and recording studio applications. Known to, and preferred by leading sound engineers.

Model 44-BX (Ribbon)..... **$129.00**
Model BK-1-A (Pressure)..... **79.50**

Model 77-D (Poly-Directional)..... **175.00**

hrc **HARVEY RADIO COMPANY, INC.**

103 W. 43rd Street, New York 36, N. Y. JUdson 2-1500

NEW LITERATURE

• **Vaco Products Company,** 317 E. Ontario St., Chicago 11, Ill., illustrates and describes screw drivers of almost every type, including all of the recessed head models, in a new pocket piece now being distributed to dealers. Of particular interest to audio engineers is a non-magnetic unit made of beryllium copper which should be an excellent tool for servicing tape recorders.

• **Minnesota Mining and Manufacturing Co.,** 900 Fauquier St., St. Paul 6, Minn., will mail upon written request two recent issues of "Sound Talk" bulletins titled respectively "Low Frequency Problems in Magnetic Recording" and "Splicing Techniques for Magnetic Tape." Both of these publications are worthy additions to any collection of magnetic recording data.

• **S. O. S. Cinema Supply Corp.,** 602 W. 52nd St., New York 19, N. Y., does an excellent job of living up to its reputation as "The Department Store of the Motion Picture Industry" with a new 80-page catalog commemorating the firm's 28th anniversary. Virtually every mechanical and electronic device required for motion picture film production is listed and priced. A handy cross-reference index assists in finding any item desired.

• **Sun Radio and Electronics Co., Inc.,** 650 Sixth Avenue, New York 11, N. Y., in its new High Fidelity Audio Equipment Catalog, features an absorbing five-thousand-word article on the subject of planning and installing a home music system. Hundreds of illustrations and descriptive text cover the many high fidelity items on the market today.

• **Cannon Electric Company,** 3209 Humboldt St., Los Angeles 31, Calif., recently issued a revised bulletin on its XL series of low-level sound connectors. Coded XLS-1953, the 4-page 2-color pamphlet contains detailed technical information and is fully illustrated with dimensional sketches, sectional drawings, and exploded views of plug and receptacle. Copy will be mailed upon request.

• **CBS-Hytron,** Danvers, Mass., has prepared a series of design rating charts and curves defining the performance of the firm's new Type 5AW4 high-vacuum rectifier under a wide variety of operating conditions. A CTS-rated tube, the 5AW4 is designed to replace the 5U4. It has electrical characteristics similar to those of the older tube, but it incorporates many of the features of transmitting tubes which afford much longer life.

• **General Cement Manufacturing Co.,** 904 Taylor St., Rockford, Ill., has just announced a new 64-page catalog which gives detailed descriptions, specifications, and prices of the complete line of G-C products for use in the manufacture and repair of electronic equipment. Requests should specify Catalog 156.

• **Engineering Products Department,** RCA Victor Division, Camden 2, N. J., applies the self-explanatory title "Power Plant Communications Systems" to a new 16-page booklet in which are graphically shown many methods of using such systems to improve operating efficiency. This publication should be in the hands of all concerned with power plant management. Requests should specify Form P-831.

• **Terminal Radio Corporation,** 85 Cortlandt St., New York 7, N. Y., is now distributing the new 1954 edition of the Terminal Audio Guide. One of the more complete catalogs of its kind, it contains 130 pages devoted solely to audio equipment for both professional and custom hi-fi installations. Classifications include: Radio and TV tuners; record changers; recorders and recording equipment; amplifiers; speakers; cabinets; parts and accessories. Copy will be mailed free on request.

DISC RECORD

(*from page 21*)

switch that is closed at the start of a recording; terminals 1 and 3 to the Micro-switch that is closed at the end of the recording; terminals 5 and 6 go to a toggle switch on the recorder base for manual control of the turntable motor.

The operating sequence is as follows:

1. Put on blank disc and screw down conical aluminum clamping nut.
2. Connect tape recorder to AUTOMATIC SPIRALLING CONTROLS plug.
3. Turn on a.c. power to both recorders.
4. Put edited tape on Ampex; set controls for playback.
5. Turn on suction pump.
6. With meter switch on HEAT, press stylus switch and set heat adjusting rheostat so that meter indicates 0 VU. Then set meter switch at microgroove or standard, as required. Set equalization and gain controls also.
7. Turn turntable switch ON.
8. Turn microscope lamp switch ON.
9. Lower cutter head to record and check groove with microscope.
11. Cut a run-in spiral by depressing MANUAL push-button (to get a lead-in groove for record changer operation.
10. Set spiralling selector at SEPARATION.
12. Start tape.

The recording is now being dubbed. This continues until a foil strip closes the contacts on the automatic spiralling control. When this occurs, a spiral groove is cut for about 3/32 in. (measured radially) and then the recording of the next selection on the tape starts. At the end of this selection, another foil marker again starts the spiralling motor, and the cycle is repeated until the last selection is being cut.

The operator may now remove the finished record, put on another blank, and start the cycle once more. The equipment described enables the average good operator to take care of about twelve recording set-ups simultaneously, instead of the usual two or three.

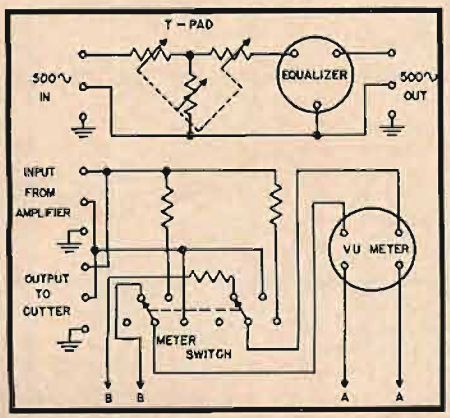


Fig. 2. The audio section of the control panel, in schematic form.

PHONOGRAPH CARTRIDGE

(from page 23)

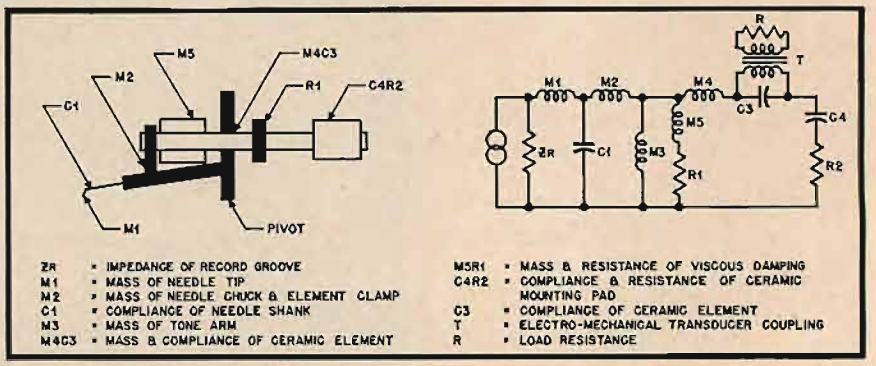


Fig. 6. Electro-mechanical equivalent circuit of a ceramic pickup cartridge.

constant. The sensitivity of this element, while somewhat lower than Rochelle Salt at 72° F., is of the same order of magnitude, and does not ordinarily require changes in associated equipment.

In all piezoelectric materials, sensitivity and dielectric constant are dependent upon temperature. In a practical Rochelle Salt pickup, maximum output occurs at 72° F., and may temporarily drop to 60 per cent of this value at 90° F. The temperature output curve of barium titanate is relatively flat and the loss of sensitivity is negligible throughout temperature ranges encountered by any phono cartridge. Because of a dielectric constant four and one-half times greater than Rochelle Salt and an ultimate strength approximately five and one-half times greater, a practical titanate element can be much smaller in all dimensions. Accordingly, the effective mass of the element and associated drive mechanism is much less. Mass must be held to an absolute minimum to prevent excessive mechanical impedance from appearing at the needle with resulting distortion and increased wear on record and stylus.

Development of the Ultra-Linear Cartridge

In the last few years, ceramic cartridges have been available for use in commercial home phonographs. A ceramic of this type has sufficient output voltage to replace the majority of Rochelle Salt units. However, response has been restricted to 4000 to 5000 cps. This limitation has usually been considered desirable. In fact, some manufacturers have required a 2500-cps "roll-off" to minimize surface noise and distortion.

In contrast to this performance, basic requirements for the Ultra-Linear ceramic cartridge were set up as follows:

1. Frequency response was to fall within 2½ db of the New Orthophonic curve throughout the range of 30 to 15,000 cps without requiring equalization in associated equipment.
2. Output voltage was to be adequate to drive standard amplifiers without preamplification.
3. Lateral compliance should be 3.0×10^{-6} cm/dyne or higher, with maximum allowable damped vertical compliance consistant with mechanical stability in all arms and changers. These values are important factors in reducing record and stylus wear.
4. The stylus should be replaceable and of a standard type.

Reinforcing the high-frequency response above the constant amplitude level a required amount is one of the most important problems of adapting an amplitude device to a complex curve such as the Orthophonic characteristic. This is often accomplished by allowing the system to resonate in this range and damping to the desired level. The result is a somewhat peaked response falling off rapidly above resonance. Needle impedance can become quite high in such cases producing mis-tracking, distortion and actual damage to the record groove.

Damping Methods

Damping is necessary in any cartridge and can be applied in a number of ways. Common practice is to rely on materials such as viscoloid, audioid, and various rubber compounds. While they are usually necessary for mounting and restraining the element, undesirable stiff-

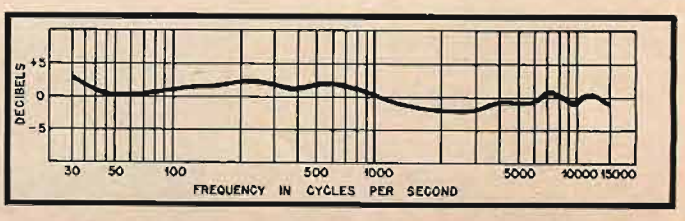


Fig. 8. Frequency response of E-V model 84 cartridge

ness and temperature instability result if these materials are used entirely. The property of a viscous material (a true mechanical resistance) can be expressed as:

$$F = kv$$

where F = force developed upon an immersed body,
k = a constant dependent upon the viscosity of the material,
v = velocity of motion.

If the viscous material were utilized as a fulcrum or restraining medium on the element, the applied force or "drive" would be greater at the higher frequencies where the velocity is increasing. Thus it is possible to incorporate a resistance for damping purposes and, at the same time, to reinforce the high-frequency response. A very low "Q" can be obtained, which is essential for a smooth response.

Viscous loading of the element is used in this cartridge by surrounding the ceramic with a viscous material. Coupling to the viscous material is adjusted to the correct value by means of a small metal vane attached to the midpoint of the ceramic. The material itself is a silicone prepared for this application in which values of viscosity, plasticity, mass, and stiffness have been established for optimum results. Silicone has excellent chemical and physical stability, particularly with respect to temperature.

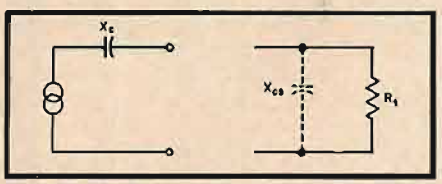


Fig. 7. Equivalent of pickup having a capacitive impedance working into a resistance load shunted by stray and circuit capacitance.

Equivalent Circuit

Equivalent circuits using electro-mechanical analogies are often useful in understanding the operation of a mechanical system. The equivalent circuit of the Ultra-Linear ceramic cartridge is shown in *Fig.* 6. The conversion of mechanical energy to electrical energy is represented by the transformer T. R_l is the actual load resistance on the cartridge.

Input Circuits

The electrical circuit of any piezoelectric device can be represented by a capacitance in series with a generator, as in *Fig.* 7. It should be recognized that the shunt capacitance of a lead and input circuit directly across the cartridge will not affect the frequency response to a noticeable extent. A voltage divider is set up consisting of the reactances of the ceramic capacitance (X_c) and the shunt capacitance (X_{cs}). The ratio of these reactances is constant at all frequencies. The net result is a given reduction in signal voltage at all frequencies.

The low-frequency response of a ceramic cartridge, however, is directly dependent upon the value of load resistance

(R_1). At low frequencies, X_c becomes appreciable and a smaller portion of the signal is available across R_1. For this reason, a minimum load resistance of 3 megs is recommended for flat bass down to the lowest frequency permitted by tone are resonance.

Output at 1000 cps is 0.6 volt as measured on the RCA 12-5-49 V frequency test record. This record represents the normal reference level for microgroove recording. *Figure* 8 illustrates an actual response curve taken on the RCA record.

Distortion tests, using the Cook "N-A Beam" test record indicate inter-modulation well below 2 per cent throughout the entire recorded range. This method is specified as it is easily duplicated and evaluated by anyone without special equipment.

Extensive "A-B" listening tests have corroborated all laboratory data and demonstrated the improved performance of the Model 84 Ultra Linear ceramic cartridge.

VIBRATION REDUCTION

(*from page 25*)

expected, the vibrations dealt with are those which occur at low frequencies. The various equations do not take resonance into account but explain the phenomenon below resonance where dynamic and static deflections are nearly the same. If one remembers that the natural resonant frequency of a solid varies inversely with its weight and directly with its stiffness, it is obvious to conclude that constructing panels as rigidly as possible helps to raise the resonant frequency to a region where damping is more easily accomplished by the use of padding and sound absorbing materials. This is easily demonstrated with the test set up illustrated in *Fig.* 6. Connected in this manner, the oscilloscope indicates the power factor of the load. At resonance, the power factor is unity and a straight line appears on the scope. Power factors at non-resonant frequencies show up as loops of various widths. If the oscillator is adjusted until a panel resonance is detected, it may be observed that the application of hand pressure to the vibrating panel will cause the straight line to open up into a loop, and by returning the oscillator it will be found that the resonant frequency occurs at a higher fre-

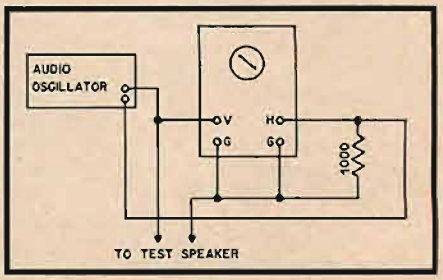


Fig. 6. Test circuit used for checking impedance and resonant frequency of speaker in enclosure.

quency. During this test, of course, one must not pick an oscillator frequency which corresponds with the natural acoustical resonance of the cabinet. In this case applying pressure to the panels will have little effect.

SAMPLE PROBLEM

Consider the bass reflex cabinet shown at (A) in *Figure* 3. Assume that it is constructed of 1-in. plywood (⅞-in. dressed), and that all corners are joined in such a manner that the panels are rigidly supported.

The top panel will exhibit the smallest maximum deflections because it is the smallest panel. The deflection of unit beam 1 is given by equation (6).

$$Z_{max} = \frac{K\ L^3}{384\ I}$$

In this case I, the moment of inertia, from Table II is .049 and

$$Z_{max} = \frac{K\ 13^3}{384 \times .049} = 117\ K$$

Since unit beams chosen from the bottom or sides would have identical dimensions, the maximum deflection of these panels would be the same as the top panel.

The maximum deflection of the front panel is determined by considering unit beam 2. In this case

$$Z_{max} = \frac{K\ 26^3}{384 \times .049} = 936\ K$$

The deflection of the back panel is similar.

Because of its shape, the area of the front panel below the port (6×26 in.) exhibits a deflection which is characteristic of unit beam 3, which is a cantilever. The deflection is given by

$$Z_{max} = \frac{K\ L^3}{8\ I} = \frac{K\ 6^3}{8 \times .049} = 551\ K$$

In determining the bracing required to reduce front and back panel vibration to a value consistent with the top panel, consider the load as the area defined by panel "P" in (B). Its width is roughly 10 inches. Since a unit beam has a width of 1 inch, and the deflection is 936/117 or roughly 8 times as severe as for unit beam 1, the required stiffness of the brace beam is 8×10 or 80 times that of unit beam 2. From Table II it may be seen that the best brace would be a 1×4. The stiffness factor equals 3.49/.049, or 71, which is close enough to the desired value. Actually it may be more desirable to use a 2×3 as shown at (B) with a stiffness factor of 245/.049, or 50, in some instances where a brace 1×4 would adversely affect the acoustics of the cabinet. Since such effects are generally not serious near the back of the cabinet, it is recommended that 2×4's be used. Here the stiffness factor is 6.45/.049, or 132. If three braces are used as shown at (C), each will support approximately one fourth of the total load. This makes the stiffness factor equal to $8 \times \frac{33K}{4}$ or 66 K. If the above calculations are applied successively to the braced panel shown at (C), two deflections are obtained.

Since both sub-panels and braces vibrate in unison, the final deflection is obtained by adding the two and the sum will be found to equal 117 K.

Because of the short length of unit beam 3, sub-panel Q (A of *Fig.* 3) requires less bracing than sub-panel P. Just to be on the safe side however, a 2×3 should be installed as shown.

The reader will note that all the braces used add up to a total volume of ½ cu. ft. which is about 1/12 of the cabinet volume.

MAGNETIC TRANSFER

(*from page 20*)

permanently magnetic condition. Increasing the number of lines of flux per unit area of the magnetized turn allows more lines of flux to be induced into the unmagnetized turns for the same contacting areas. Thus the initially unmagnetized turns now have more lines of flux to be cut by the coil of the playback head. This in turn subsequently allows for a greater playback or transfer output. The fact that the signal on the originally unrecorded turns of wire appears as a series of bursts when viewed on an oscilliscope screen probably is dependent upon the manner in which the turns of wire lie against each other. That is, this is probably an effect of geometry.

The decrease in amplitude of the transfer signal as the distance between the magnetized and unmagnetized portions of wire increased probably came about from the fact that the actual magnetization of one turn of wire by the next was an inefficient process. That is, there was always a magnetic loss and consequently the actual transfer of magnetism became less and less the further along the unrecorded wire one went. This continued until no signal was left on the wire.

The rise of the curves of transfer *vs.* increasing recording current was believed based on the fact that as the current was raised, more lines of flux were induced in the wire and consequently into the unmagnetized turns and therefore, was the cause of increased trans-

TABLE 1

Sample No.	Transfer 1000-cps output	Transfer	Recording Current-ma		
1	17	−25	.47		$H_c = 320$
	22	−25	.70		
	31	− 4	1.30		$B_r = 2500$
	32	+12	2.00		
.004 in.	32.5	+16	10.00		
	32	+ 8	30.00		
	31.5	+ 9	50.00		
	31	+ 3	80.00		
2	20.5	−21	.47		$H_c = 260$
	30	−16	.70		
	31.5	− 4	1.30		$B_r = 1900$
	32	0	5.00		
.004 in.	31	− 4	10.00		
	30	−15	30.00		
	28.5	−16	50.00		
	27	−20	85.00	(max)	
3	12–17	−21	.47		$H_c = 440$
	17	−25	.70		
	31.5	−15	2.0		$B_r = 1080$
.004 in.	32	−10	5.0		
	32	− 6.5	10.00		
	31	−12	50.00		
	31.5	−18	85.00	(max)	
4	18	−25	.47		$H_c = 250$
	24	−22	.70		
	31.5	− 3	2.0		$B_r = 1480$
.004 in.	32	− 2	5.0		
	31	− 6	10.00		
	26	−21	50.00		
	23	−22	85.00		
5	18	−25.5	.47		$H_c = 230$
	25	−24	.70		
.004 in.	32	+ 1	2.0		$B_r = 2800$
(Another	32	+ 8	5.0		
source)	31.5	0	10.0		
	31.5	− 7	20.0		
	30	−11	85.0		
6	24	−23	.47		$H_c = 280$
	30.5	−12	.70		
	32	+ 8	2.0		$B_r = 2600$
.0036 in.	32	+10	5.0		
	31.5	− 8	10.0		
	30	−10	50.0		
	30	−12	85.0		
7	22	−22	.47		$H_c = 320$
	28	−20	.70		
	31.5	− 6	2.0		$B_r = 2300$
.0036 in.	32	+ 6	5.0		
	31.5	0	10.0		
	30.5	−13	50		
	29.5	−20	85.0		

fer. The fact that the curve leveled off and decreased was probably a self-demagnetization effect of the tiny magnetized magnets making up the wire. As the recording current increased, the magnetic fields of these small magnets affected each other, i.e., demagnetized each other, to a greater and greater extent. This could account for the transfer decrease observed.

The reason for the higher maximum transfer value for .004-in. wire as compared to .0036-in. wire of the same remanence is believed to be based upon the following explanation: The number of lines of flux for a larger sized wire is greater than for a wire of finer diameter, both wires having the same B_r. That is, transfer appears to be dependent not on the number of flux lines per unit area but rather on the total number of lines for the area involved. These would increase as the area increased even though the B_r remained the same.

Conclusion

It was learned that the remanence and coersive force of a stainless steel recording wire had a definite influence upon the transfer characteristics of the wire. Increasing remanence caused higher transfer values for a given recording current. Increasing coersive force necessitated higher recording currents in order to attain the maximum transfer value of the wire. In addition, it was noted that the maximum transfer value attained was lower with wires of finer diameter, indicating the direction to be followed to reduce transfer.

The author wishes to thank the Wilbur B. Driver Co. for their kind permission to publish this article.

SOUND HANDBOOK

(*from page 28*)

occasionally the oscillation is at so low a frequency that it can be observed as a very slow oscillatory motion of the speaker cone, sometimes referred to as "breathing."

The standard cure for such regeneration is the use of added R-C sections of filtering, called de-coupling networks, as illustrated in (B) of *Fig.* 15—4. De-coupling networks improve the anti-hum effectiveness of the filter, but their primary purpose is to prevent alternate stages from having a common load impedance. No more than two successive stages of amplification can be fed from the same B supply point without danger of regeneration. Phase-splitters that use two tubes must be considered as two stages, and the preceding amplifier should be fed from a de-coupled point.

Hum and Noise

We may now turn to a more detailed consideration of the way in which noise is introduced into the signal channel, and of ways to combat it. Although the additional components may be periodic rather than composed of random frequencies, they are classified as noise because of their irritating nature, in accordance with the definition of noise of the American Standards Association.

Noise can be readily generated by defective tubes, resistors, capacitors, lead connections, and so on. We will confine ourselves here to discussing noise inherent in original design rather than that resulting from defective parts. Three types of noise will be considered: hum, "microphonic" disturbances, and thermal noise. Two other types of noise which the signal may pick up are record surface scratch and turntable rumble. These are associated with mechanical activities of the pickup and of the phonograph motor rather than with electronic flow in the amplifier, and are referred to in appropriate chapters.

Probably the most common "bug" in individually built or design model audio amplifiers of high gain is hum. Modern low-output pickups and tape reproducing heads require amplifiers of such gain that several potential sources of hum, which might not have had any significant effect in an amplifier of lower gain, must be carefully eliminated.

Hum Level

The amount of hum at the output of an audio amplifier, or at some point within the amplifier, is most often described in terms of the decibel relationship between the hum voltage or power and the maximum signal at that point. This procedure is followed in recognition of the fact that the tolerable amount of hum depends upon its relative level in the total range of amplitudes being reproduced. The absolute amount of hum produced by a public address system in a large hall, for example, may be considerably greater than the hum produced by a low-power living room amplifier, but the amount of noticeable hum of the two may be the same.

A relative rating of this type, however, must be used with care. There is a certain amount of amplifier hum output which is introduced above the volume control and which therefore remains constant regardless of the volume control setting and the level of reproduction. This hum will have a higher ratio to the signal when soft passages are being reproduced. It may leap into prominence if the loudspeaker system is especially efficient and if the maximum power capacity of the amplifier, upon which the hum rating is based, is far in excess of the power used. In the latter case it is important to know the relationship of the hum level to the maximum electrical output actually in use rather than to the output capabilities of the amplifier. The absolute minimum

value of the output hum of an amplifier, in microwatts, may therefore be a useful rating to have in addition to the relative rating in db below maximum output.

The Federal Communications Commission regulations permit a total hum and noise level for AM broadcast stations, exclusive of microphone and studio noises, of 50 db below 100 per cent modulation (representing maximum audio level) at frequencies between 150 and 5,000 cps, and 40 db down from the maximum signal outside of this frequency range. FM stations are required to keep their hum noise level 60 db below the maximum amplitude of passages being broadcast. Modern amplifiers should, and commercial amplifiers usually do meet or exceed the FM requirements.

If a 10-watt amplifier has 10 microwatts of hum output the signal-to-hum ratio is 10/.00001, or a million to one. Converting to db by the power formula:

$$db = 10 \log \frac{P_1}{P_2} = 10 \log \frac{1{,}000{,}000}{1} = 60$$

we find the hum level to be 60 db below 10 watts.

It would be extremely difficult to measure 10 microwatts in the low-impedance secondary of an output transformer, as the voltage involved is minute. The voltage across the relatively high-impedance primary winding of the output transformer is much greater, and may be measured with a low-scale a.c. voltmeter or calibrated oscilloscope of known volts/inch sensitivity. (If the latter is used, peak-to-peak indications are employed directly; sensitivity is normally rated in sine-wave r.m.s volts.)

The secondary is connected to the proper value of resistive load rather than to the loudspeaker, in order that the impedance rating of the primary, which is a reflected value, be accurate. The square of the voltage across the primary, divided by the primary impedance, will then give the power of the hum output. For example, 0.2 volts across a 4,000-ohm secondary indicates a power of 10 microwatts.

The hum level of voltage amplifiers is calculated in the same way, except that the db/voltage formula $[db = 20 \log (E_1/E_2)]$ is used.

Examination of the Fletcher-Munson curve will reveal the fact that 60-cps hum, at the usual order of intensity that might be expected of such a disturbance, requires an intensity level at least 10 db higher than that of 120-cps hum to be heard with the same loudness. Suppression of hum at harmonic frequencies of the line is therefore especially important. One of the best methods (and certainly the simplest) for checking final noise level in a complete home reproducing system is a listening test, which automatically takes into consideration speaker efficiency, hum frequency, and acoustical conditions under which the reproducing system will perform. With the volume control set for high but usable volume and no program material present, an exceedingly low hum level would be represented by little or no audible sound in a quiet room at a distance of two or three feet from the loudspeaker.

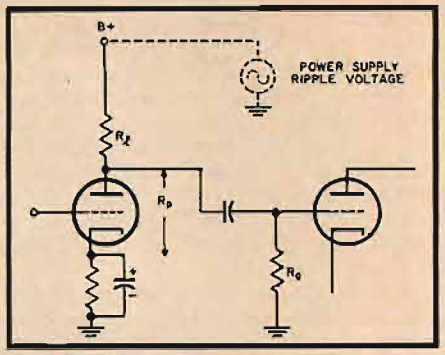


Fig. 15—5. Application of power supply ripple voltage to the voltage divider consisting of plate resistor as an upper arm, and the parallel combination of tube and grid resistor as lower arm.

Sources of Hum

The sources of hum in an audio amplifier may be divided into four main categories:

1. Insufficiently filtered B supply, the common garden variety of hum.
2. Inductive or capacitive pick-up, by some point along the signal channel, from components or leads carrying a.c. or pulsating d.c.
3. Coupling from a.c. heaters.
4. Differences of a.c. potential along the chassis or between different chassis.

Hum is also introduced into the signal in r.f. circuits, in which case it is called "modulation" or "tunable" hum.

B+ Filtering

Alternating ripple in the plate supply of a resistance-coupled stage is applied to the voltage divider formed by the load resistor and tube impedance and is coupled to the grid of the following stage, as illustrated in *Fig.* 15—5. It is sometimes thought that B+ hum is introduced by plate modulation of the electron stream in the tube being supplied, but vacuum tubes are relatively insensitive to plate voltage changes, and the fractional ripple voltages involved cannot have an appreciable effect on current flow. Thus the tube does not have to be in its socket for ripple in its plate supply to be introduced into the signal. As a matter of fact less plate supply hum will be introduced with the tube in place than without it.

The voltage division of plate-supply ripple will be most favorable to a low hum level when the tube has low plate resistance, when the circuit uses a high value of plate resistor, and when the grid resistor following, which is effectively in parallel with the plate resistance of the tube, is low in value. Pentodes are more susceptible to B+ ripple than triodes because of the fact that their plate resistance is higher, and because electron flow in the tube may be screen modulated by the ripple voltage. The screen requires a more highly filtered supply than the plate.

When there is doubt as to whether hum is due to inadequate filtering an extra resistance-capacitance section may be temporarily connected in series between the suspected stage and the B+ line. For the output stage the test circuit would have to be an inductance-capacitance section.

TIRED MAN'S CABINET

(from page 27)

It goes without saying that the work has been a great deal of enjoyment. At present the biggest remaining problem is the elimination of a small amount of hum which seems to originate in the output stages of the tuner. It has recently been written that no tuner on the market possesses all the desirable qualities of quietness and freedom of hum that could be found in a good high fidelity amplifier. Some day perhaps someone else may be confronted with this problem and will write a story on ways and means for substituting the two 6J5 output tubes with something more quiet. This again falls into the technical field and the writer must wait until someone else more qualified is sufficiently annoyed with this problem that he publishes something about it.

RECORDS

(from page 40)

be magnified, and a slight rocking back and forth gives an extremely accurate "geared down" adjustment to exactitude. It took a brain to think that one up.

The gadget wasn't designed directly for stylus examining, of course, and there is a bit of trouble sometimes in operating on your needles, since styli are not ordinarily mounted on flat planes. But I've managed usually to rest the device on some handy part of the cartridge and so locate the jewel in reasonably steady focus. It is definitely possible with this "mike" to see stylus damage, though the magnification is about the minimum one can get away with.

My "Vista" came direct from Japan (at an absurdly low price there) but I've seen it advertised in the U.S. and you'll probably find it in the ads that feature such imports. Sold under various trade names.

Maximilian Weil's Stylus-Disc is a somewhat controversial offering, it seems, that can easily involve one in the kind of mathematics that we used to fight about in the first days of the microgroove—remember? (Who has the most distortion at what diameter?) I'll steer clear of it—I've given the disc a good trial on all the styli I could find hanging around, checked against both the sound and the sight, via the "Vista," previously described.

The Stylus-Disc, from Audax, is of a soft material, cut with bands of eccentric grooves that swing the pickup from side to side heavily. In order to approximate the friction of a musical groove, they are modulated with a fixed high pitched tone, of about 3000 cps. You're supposed to play the bands with your pickup, extra-weighted with a quarter dollar on the end, and observe what happens. "Gray" effects indicate stylus trouble. The company warns that the disc is sensitive and detects incipent damage before it actually is risky.

Well, I began with incipent guilt, expecting to find most of my much-used points in unmentionable condition. No such thing!

I didn't get any "gray" effect or any effect at all for the first five or six tries, including an Audak diamond that I was sure must be pooched out. By golly, I looked at it with "Vista" and it *looked* OK too. Check—negative. But I had to find at least one bad needle, and couldn't. An old GE 78 sapphire—nope. OK. A still older fixed-stylus early GE cartridge? OK. A CAC, much used. OK. And "Vista" said yes, too. This was too good to be true.

Enfin—I found a CQ Astatic with a diamond shaped sapphire point; that is, a sharp triangle where the round ball should have been. That should do it, and it did. Not gray, but shiny, however; it seemed to polish the Audax grooves. Didn't matter—I could see the change in their looks. Bad point, by every test. (I broke it off, just to end *that* experiment. An old Pfanstiehl sapphire cartridge with a lop-sided flat (via "Vista") made a fine gray trace on the Stylus-Disc. Check again. Mathematics or no, the prognosis seemed fairly good, though by this time I'd just about used up the available test grooves, both microgroove and 78.

Aha! A diabolical idea. I pulled forth a brand new, untouched crystal cartridge with an ALL-GROOVE sapphire. What would the Stylus-Disc do about *that?* I am happy to report that the results were emphatic. The all-groove point, brand new, produced a lovely, healthy band of dark damage on the microgrooves, fully as bad as the worst used point I'd tried! On the 78 side of the disc the same all-groove point seemed to do OK. Moral: Keep away from all all-grooves for your LP's and 45's.

Point Pressure

How about measuring stylus pressure? That's another tough problem for the home user, though the professional engineer and the advanced amateur may well have the requisite tools. Most changer and arm and cartridge makers blithely talk about adjusting stylus pressure with never a thought as to how the poor dope at home is supposed to go about doing it. Baby's bath scales won't help and not even a postage letter weigher is any good—not with our present gram pressures.

Again, I've tried this and that home point pressure device without much luck so far. Note well that an excellent new solution for the home is the GE arm with the built-in scale balance, a type of gadget until now quite unavailable for ordinary home use, at lowish cost. But what to do with some other arm—any other among millions?

I've tried the Clarkstan pressure gauge and must report a fundamental trouble with all spring scales that operate from underneath the pickup point, resting on the turntable or on the hand. The spring is in itself accurate enough; but its end, the tiny cup into which you place the stylus point, moves up and down in *a curved track*, an arc. That means that either the pickup or the supporting base must move forwards and back as the stylus moves up and down. If not, things tend to jam and the reading—at such tiny pressures as a few grams—can go way off. Of course if you can place the scale sidewise to the pickup so that the arch is in line with the arm's swing, the trouble is greatly decreased (though not removed since the arm's travel is also an arc) but in most machines there isn't room for this sort of trial.

Weathers, the FM pickup firm, has a new stylus pressure gauge that hangs from above, and removes this trouble neatly, allowing for considerably more accurate readings, as far as I've been able to observe. No springs—a system of simple

levers and a circular turning weight gives readings from 1 to 10 grams with fair exactitude. You hook the bottom under the pickup and lift the whole works, by a ring, slipped over your finger; take the reading when the music stops playing or as the point loses contact. Basically a sound idea and I recommend it, or similar devices of the sort, when and if. But I've a few annoyances to air, of the minor-irritation sort, in the hopes that Weathers will make changes.

First, the two little levers slip over pins to assemble the gadget. Fine—but every time you put it down, and every other instant in between, the things fall off again. Extremely exasperating, and the levers will be lost behind the radiator or inside your amplifier in a day or so if I know most people's habits. The levers should be fixed, or at least shouldn't fall off in every breeze! Secondly, the thing is right-handed. I'm lefty. Got to break your neck or climb out the window and look in, to read it. Why not print both sides. (One side reads more exactly, but even so. . . .) I'm also a bit suspicious of the friction at the top of the little indicator arc; it's at a crucial point.

All in the spirit of better Audio, etc., and I recommend the gadget for those who would Know the Worst as to their own pickups' pressure. Final note: Be sure to hook the Weathers gauge directly at the stylus point spot on the arm, not ahead or behind. A short distance either way reflects a false reading by several grams.

Dubbings' Tests

And now, finally, to the trickiest and most complex set of gadgets of the month, the Dubbings Co. test records and the Test Level Indicator.

As for the first Dubbings disc, D-100, there's not much to say and all of it good. A straight frequency run in the usual bands heads things off, and will tell a lot of people whether their phonographs produce highs and lows, or merely middles. 30 to 12,000. (High enough—a 15,000-cps band isn't going to stand up and many people can't hear it anyhow.) A 45-second unmodulated band rather neatly—if you follow the excellent and simple directions—sorts out audible hum and rumble. A 3000-cps steady tone uses your ear in its best range to check wow. A set of 400-cycle bands each up 3 db over the last is for tracking and compliance; Dubbings says a home machine is OK if it plays the first three without fuzziness. My system played 'em all very nicely. (Seems like I need some really good punk equipment around. I can't get anything to go wrong.) Sides A and B are identical—two records for the price of one, or something. (But a good idea.)

D-101 gets more complicated. It's called *The Measure of Your Phonograph's Equalization* and includes complete frequency band runs according to the four main recording curves, labelled Columbia LP, NARTB, AES, and RCA New Orthophonic. Again, both sides are identical. Level-setting bands at 1000 cps occur at both the beginning and the mid-point of each range and are easily picked out by sight. Good.

Here we are at the ragged edge of the whole amateur-professional schism—and I much admire Dubbings' enterprising and reasonable fling at that old dragon, equalization, a monster that has slain many of the best of us, on both sides of the professional fence. It's sorta hopeless—not even Dubbings can untangle the mess; and there are complications for the amateur here that are almost overwhelming. Thanks to somebody, the simple explanations of the earlier

D-100 are continued on this disc, to make the best of the trouble. Moreover, a lot is left to the listener's good ear, which is an immeasurably wise thing to do.

With this disc alone, you can quickly get a good idea of equalization settings on these four familiar curves either through the usual bass and treble tone controls minus separate equalizer system, or via the fixed equalization positions now so popular, the record acting as a check on their performance. *But* you must of course have a voltmeter. No other way, ordinarily, to measure the signal strength. Cheap ones aren't accurate. Good ones cost. And that is that. Cuts out 99 per cent of phonograph users.

—But not quite. Dubbings, having got this far, has found itself bound to push on, and the Test Level Indicator is the result, a gadget strictly for home use that is designed to take the place of a fancy and complex voltmeter at a low cost, about $3. With it, you can use the Dubbings records to measure your phonograph's exact output to the speaker on any of the test LP bands, and thus you can check its frequency response and equalization quite simply.

The gadget mounts three small light bulbs (radio dial type) in a small plastic box; when the thing is hooked onto your speaker leads via alligator clips, the bulbs light up progressively at 3 db differences in level. You set it at "neutral" via the level-set bands at 1000 cps on the test records; then you may check deviation as accurately as a couple of db (3 db is as small a difference in sound intensity as you can hear) in your machine's response from the recorded frequencies, for each of the recording curves. (i.e.—for those who may be unfamiliar with this sort of jargon—if your set plays the AES-curve bands "flat" all the way up and down when it is set for AES response, it is operating correctly, and will reproduce an AES-curve musical record in correct tonal balance, correctly equalized.)

A neat and intriguing little device and it performs admirably in every way—except for one most unfortunate weakness: the bulbs burn out, with too much volume. *Do* they burn out!

Dubbings pessimistically gives buyers a couple of spares; I killed nine of them, in my diabolic way, in a half hour of dickering. As I say, I have a heavy hand on light equipment, and use it deliberately in such cases. But I fear, nevertheless, that others may have the troubles I had and I'm wondering whether something couldn't be done about it, to make this extremely useful gadget a bit more shock-resistant.

Specifically, I burnt out bulbs in these easy ways. (1) Though I carefully kept the volume down low, as instructed, I got impatient with the tone signal test bands and moved the pickup onward a few times. Mostly, all was well; but one slightly firmer drop of the stylus produced a mild plop in the speaker—and burnt out two bulbs. (2) I turned on my phonograph motor. The "pop" of the switch (my muting condenser was loose) burnt out the whole set of bulbs instantly. That could happen with any old switch in the nearby electrical neighborhood. (3) I clipped the test leads onto a speaker plug, loosening it slightly. The speaker line was jostled loose for an infinitesimal fraction of a second a bit later. Bulbs blew. (4) In rearranging my equipment I happened to pull out a phono input plug in the back of my amplifier, forgetting that the Test Indicator was still connected. When the ground connection broke for a tiny instant, with the usual loud hum—the bulbs blew, all of them. Took me quite a while to figure what had done it that time.

Enough said? and yet this is an excellent device, on a sound and reasonable principle. All that is needed is some sort of safety factor. Neon bulbs—two would be enough—might do it, but with a transformer the price would be up. Perhaps an overload circuit of some sort ahead of the bulbs would do it. I'm going to try 4-volt bulbs instead of the 2-volters (#40 instead of #48) to see what may happen then. What say Dubbings? Let's not lose such a good idea.

You can use the Dubbings records with a "real" voltmeter and I highly recommend them to all readers who rank between the utter amateur and the man who already owns his own oscilloscope and signal generator.

P.S. One question, largely curiosity on my part. When volt readings are taken with the speaker in parallel in the output circuit—as Dubbings suggests—is not the response affected directly by the speaker's operation, including the effects of the enclosure and even of the room—standing waves, for instance? My own readings suggested that this was the case. An ideal speaker enclosure in an ideal acoustical situation (not for listening but for speaker performance) would reflect pretty much the electrical output of the system; but few home owners have such conditions.

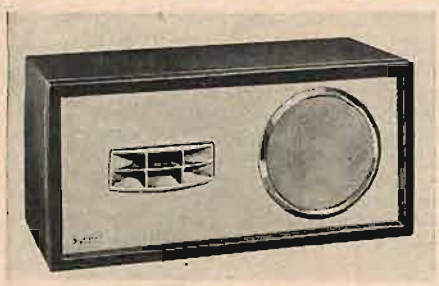
I doubt if the deviations thus occasioned are important enough to spoil the readings from these test discs, yet some users may be unduly disturbed at what seem to be peaks and valleys in over-all response, even when the average is set to equalize a given curve. Not vital because, as I well know, many a home system, including a vast number of mis-used hi-fi outfits, are so drastically and horribly off on equalization that even an accuracy of 6 or 8 db in these records would be plenty to do a good corrective job. How many times have I seen—and heard—a system exuding highs at roughly 20 db boost from the flat or correctly equalized position! Let's not worry about details.

THE AUDIO FAIR IN REVIEW

(from page 32)

entry into the audio industry with its first Fair appearance. High-fidelity equipment on display was easily recognized as coming from a firm thoroughly versed in building electronic devices to a high standard of precision.

"High-fidelity speaker performance in a small package" was the introductory theme of **Jensen Manufacturing Company's** new "Duette" two-way speaker system. Comprising a special 8-inch woofer plus a multicell horn-loaded compression-



type tweeter, the Duette is housed in a compact enclosure which may be mounted in a bookshelf or used on a table where space is restricted. Sharing interest with the Duette were Jensen's new H-530 and H-520 coaxial speakers, both of which offer an exceptionally high standard of performance within their respective price ranges.

Klipsch and Associates, along with demonstrating the original Klipschorn, introduced the Rebel III, a smaller back-loading enclosure designed to improve the performance of direct-radiator speakers. Moderately priced, the Rebel III is an impressive performer.

The popularity of the Baruch-Lang miniature corner speaker system was well evidenced by the crowds which attended the exhibit of **Kloss Industries.** Stressed in the display, as in the firm's current advertising, was the fact that Kloss was the original manufacturer of the Baruch-Lang unit, and that the company sells direct to consumers at considerable savings.

An improved version of the Karlson Ultra-Fidelity enclosure, a handsome-appearing cabinet which utilizes the exponential slot principle, held the spotlight in the exhibit of **Karlson Associates, Inc.**

John Karlson, company president, gave frequent lectures in order to familiarize acoustic engineers and audio hobbyists with the unique approach to speaker matching which allows a relatively small enclosure to "surpass the bass response of a 31-foot horn."

In its second Fair appearance, **The Kelton Company** displayed an entire line of economically-priced high-fidelity music systems, also a number of individual components. Here, incidentally, is excellent evidence of how rapidly the audio industry is expanding; last year the company's display was devoted almost entirely to the first public showing of the Kelton speaker.

A new line of miniaturized professional preamplifiers, line amplifiers, and power supplies were featured in the exhibit of **Langevin Manufacturing Corporation.** Of equal interest were the standard audio devices for sound service organizations and those for wired-music services, for which Langevin has long been noted.

In an initial Fair appearance, **Kingdom Products, Ltd.,** introduced the Lorenz woofer-and-tweeter combination which, when used with the Kingdom high-pass

filter and specially designed enclosure, provides an economical means of achieving excellent audio performance. Also intro-

duced was the English-made Emitron Type KT-66 tube, known the world over as an excellent output tube for audio amplifiers.

True, it was a little on the bulky side—but Brother how did it sound. Thus is interpreted this observer's reaction to the new Model D-55060M speaker system shown by **James B. Lansing Sound, Inc.** In reality a scaled-up version of the company's well-known Model 34001, the new unit makes use of two woofers and a theatre-type tweeter to give forth with music which is plenty cool, son, plenty cool.

The Fair was chosen by **Livingston Electronics Corporation** as the propituous occasion for announcing its entry into the commercial record field. Both binaural and standard microgroove records will be distributed under the Livingston label, with a catalog of recordings currently available now on the press. Equipment spotlighted in the Livingston exhibit included the company's binaural reproducer arm and a new twin-channel stereophonic amplifier.

Stereophonic sound from a single input source was the center of attraction in the exhibit of **Madison Radio Sound,** participating in the Audio Fair for the first time. The firm's Multichannel amplifier is designed for either single or binaural input, and is startling in the dimensional effect it gives to the former—at times approaching the qualities of a dual-input system.

The long-awaited introduction of the Model M80 professional tape recorder brought literally thousands of visitors into the exhibit of **Magnecord, Inc.** And, it may be said with full truthfulness, their enthusiasm was without limit. In addition to occupying display space at the Fair itself, Magnecord engaged a large parlor on the New Yorker's mezzanine to conduct a press exhibition of the M80, as well as the newest Magnecord binaural equipment. Response of those who attended was more than gratifying.

The keynote of the display of **Jeff Markell Associates** is well defined in a statement by Jeff Markell, company president—"We are designing all our units to make audio cabinetry look like furniture you would want in your living room rather than like equipment enclosures." How well

Mr. Markell's company is carrying out this premise was dramatized by a stunning enclosure which successfully solves the problem of vibration transmitted mechanically from speaker to equipment housing. Known as Model RC-130, the unit employs shock mounting in its construction to achieve the desired isolation of the two basic sections.

Appearing as a Fair participant for the first time, **H. S. Martin & Company** introduced its new Model 153-T AM-FM tuner

with built-in control amplifier. Sensitivity of the tuner is one microvolt for 20 db of quieting. Both tuner and preamp are designed to be powered by the Martin 352-B power amplifier. The 153-T is notable for its inviting appearance as well as for its exceptional performance.

Highlighted in the exhibit of the **Mark Simpson Manufacturing Company** were the new Masco "Custom Ten" 10-watt high-fidelity amplifier, the "Concert Master" 20-watt amplifier, and the new Model 53 tape recorder. Although low in price, the "Custom Ten" provides five equalization curves for all modern records, separate bass and treble tone controls, and a bass- and treble-compensated volume control. The new Masco tape recorder incorporates a two-motor mechanism and is available with or without built-in AM tuner.

Along with the highly-regarded Model 50W-2 50-watt amplifier, **McIntosh Laboratory, Inc.**, displayed a new 30-watt amplifier, also a new preamp-equalizer unit which is remarkable in the flexibility of control it provides. Designated Model C-108, the new McIntosh "front end" features push-botton switches which permit accurate logging of tone control settings for various recordings. In appearance too, the C-108 is a distinct innovation.

Precision with a capital P was the order of the day in the exhibit of **Measurements Corporation.** As at previous Fairs, this was the spot to go for meeting many of the country's leading design and development engineers. Jerry B. Minter, Measurements vice-president, was on hand a great part of the time receiving congratulations on his election as president of the Audio Engineering Society.

It would be a little redundant to review the **Minnesota Mining & Manufacturing Company** exhibit on the basis of the various types of Scotch brand magnetic tape which were shown; every conceivable type of tape was there, period. On the other hand, the 3M display must be singled out as highly exceptional because of the excellent literature which was distributed. The writers of these pieces are to be commended for their ability to describe the technical side of magnetic recording in a vocabulary which makes it entirely understandable to the layman.

Assembled in the exhibit of **Newcomb Audio Products Company** was one of the more inclusive showings of fine audio equipment in the entire show. Along with the company's complete line of high-quality amplifiers and transcription players there was featured an excellent demonstration of two-channel dimensional sound. Binaural or stereophonic—call it what you will—when played the Newcomb way it is an unforgettable experience.

A number of unique electronic developments were unveiled in the showing of the new 1954 radios and radio-phonographs introduced by **Motorola, Inc.** Among them

was a new oval-type inverted speaker which offers improved tone and greater speaker area than conventional units for similar application. Among completed instruments, the bulk of attention was focussed on the Motorola Sonata radio-phono, a low-cost table combination which includes an AM receiver and three-speed record changer.

Orradio Industries built an intriguing display around the firm's use of colors—brown, green, and red—to distinguish various grades of Irish brand recording tape. The completeness of the Irish line is entirely in keeping with the Orradio advertising theme—"World's Largest Exclusive Magnetic Tape Manufacturer."

The Fair offered no more impressive showing of home tape recording equipment than that assembled in the suite occupied by **The Pentron Corporation.** A Pentron accessory, a 4-position electronic mixer which may be used with any tape recorder, came in for more than due share of attention. Through use of this unit as many as four microphones and/or tuners and record players may be mixed into a single input, this affording the flexibility usually associated only with professional equipment.

Clearly proved in the suite occupied by **Permoflux Corporation** was the fact that excellent reproduction of sound does not necessarily entail high cost. Permoflux, through its excellent moderate-priced speakers, has gone a long way toward popularizing the hobby of custom building home music systems. And, through the high-fidelity headphones which are a virtual necessity for true binaural listening, the company has built a unique stake in the professional audio field as well.

Making an initial Fair appearance, **Pickard & Burns** introduced a complete assembly of high-fidelity components which were remarkable in their performance. Incidentally, this display was unique in the fact that its prime function was to bring the equipment developed by Pickard & Burns to the attention of prospective manufacturers rather than end users.

If for no other reason, the exhibit of **Pickering and Company** would have excited attention because of the great interest

of visitors in the Model 260 turnover-type diamond-styli cartridge, which received its public preview at last year's Audio Fair. But other reasons there were aplenty; among them was the Pickering audio input system. This company should take justified pride in being virtually the first to sense the need for a "front end" of professional precision for use with home music systems, and to make it available at reasonable cost.

Pilot Radio Corporation, in its first Fair appearance, introduced a number of new tuners and amplifiers in the moderate price range. Outstanding was the Model AF-824 tuner, which includes among its features a built-in preamplifier with bass and treble tone controls, as well as variable equalization for both domestic and foreign recordings. Engineers and hobbyists alike were impressed by the steps Pilot is taking to make excellent audio performance available at prices well in keeping with modest incomes.

Portable Gramaphone Company, another of the Fair's newcomers, introduced the new Dorset portable phonograph, at this writing the only portable to employ a Gar-

rard record changer. Other quality features of the Dorset include a 6-tube amplifier, an 8-inch high-quality speaker, record compensator, and tone control, all of which contribute to the Dorset's impressive performance.

Precision Electronics, Inc., whose Grommes Model 50PG was one of the first amplifiers to bring true high-fidelity performance to the moderate-price field, gave evidence that the firm's efforts in this direction are unabated, with the introduction of Type RC-1 record compensator. For connection between magnetic pickups and preamplifiers which are not equipped with controls for record equalization, the RC-1 provides correct playback curve for all types of recordings. It is also equipped with a slide switch which changes loading to match Pickering, G. E., and Audak pickups.

Support for the belief that there is going to be a big market for long-playing tape reproducers was seen in the remarkable interest commanded by **Presto Recording Corporation's** Model PB-17A, a unit which plays as long as eight hours without attention. The PB-17A makes musical programs, with or without commercials, available to hotels, restaurants, industrial plants, department stores, etc., at moderate cost. Presto's other new tape equipment, the RC-11 recorder for example, also met with great approval, as did its extensive line of disc recording equipment. In the words of Thomas B. Aldrich, Presto's sales manager, "—disc recording, in spite of tape, is a long way from bowing out of the picture."

A repeat hit was scored by **R-J Audio Products.** Fair visitors never seem to tire of hearing clean, fundamental bass 'way down in the organ-pedal-note range issuing forth from an enclosure no higher than a bookshelf and only a couple of feet in length. This year, to animate the display, the wooden top of the R-J cabinet had been replaced with Plexiglass, thus disclosing constructional details.

By far the most inclusive display ever to grace an Audio Fair was that presented by **Radio Corporation of America's RCA Victor Division.** Occupying a dozen rooms, RCA pulled out all the stops in presenting an exhibit which had as its focal point the new RCA custom-built high-fidelity radiophonographs, as well as the company's new line of amplifiers, tuners, speakers, and tape recorders. In addition to showing equipment which is now available, the exhibit included an "in-the-future" demonstration of stereophonic sound. A number of brief lectures by well-known RCA engineers contributed further to make this exhibit one of lasting and pleasant impression.

The Radio Craftsmen, Inc., introduced in its exhibit a new packaged home music equipment assembly consisting of tuner, amplifier, three-speed record changer, and a coaxially-mounted dual speaker system. Heretofore, the company has sold only separate components. Other new Craftsmen developments shown were the C900 FM tuner with 1-microvolt sensitivity, and the C210 high-fidelity dual-chassis TV for remote control.

The FM tuner to end all FM tuners was given its first public showing by **Radio Engineering Laboratories.** Known as the REL Model 646-C, it includes virtually every known refinement for realizing the full potential of FM transmission and reception. Adding a touch of nostalgia to the REL suite was the original FM receiver designed and constructed by Dr. E. H. Armstrong.

New developments in magnetic recording materials were the center of attraction in an inviting display by **Reeves Soundcraft Corporation.** Sharing featured spots were Reeves' new Mypar Lifetime recording tape, and a strip of CinemaScope film. Mypar is a tape of tremendous strength, and is virtually non-breakable in normal usage. CinemaScope, on whose development Reeves worked in conjunction with Twentieth-Century Fox, is largely a refinement of the Reeves Magna-Stripe process and contains four magnetic sound tracks as well as picture area on 35-mm film.

One item which had to be seen as well as heard in order to be fully appreciated was the high-fidelity amplifier ensemble shown by the **Regency Division of Industrial Development Engineering Associates.** Not inexpensive,—it sells for close to a thousand dollars—the Regency system matches in visual beauty the perfection of its sound quality.

The Fair presented no more impressive showing of precision record-playing equipment than that assembled by **The Rek-O-Kut Company.** The latest Rek-O-Kut turntables are supreme examples of excellence in both mechanical and electrical construction. Also coming in for a great share of attention was an improved version of the Rek-O-Kut portable disc recorder.

In addition to displaying the excellent characteristics of Revere tape recorders, **Revere Camera Company** in its exhibit received a great play from visitors with the demonstration titled "Can You Hear 17,000 Cycles?" Tones of 10, 12, 15, and 17

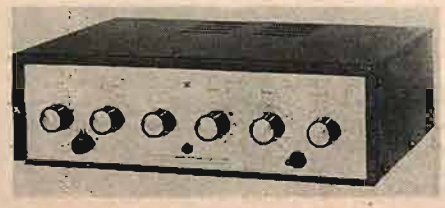
kc were recorded and played back on a standard Revere Model T-10 recorder; participants in the test were split in their curiosity as whether they could hear the 17-kc tone, and whether the recorder could reproduce it. About 40 per cent of the listeners heard the tone, which was a 100 per cent indication of its existence.

An extensive line of cabinetry ranging from "Kits to Consoles" for housing hi-fi equipment and TV receivers was shown by **River Edge Industries.** River Edge has secured the cooperation of many leading equipment manufacturers, who furnish pre-production drawings of audio and TV chassis prior to distribution to dealers, and thus is able to supply cabinets pre-drilled and pre-cut for most standard amplifiers, tuners, and record players.

Engineering features of the British-made Collaro record changer were clearly shown in the exhibit conducted by **Rockbar Corporation,** American distributors. Highly-regarded and widely-used on the Continent, the Collaro changer is well on the way toward duplicating the experience in this country. The smoothness of Collaro changer operation was particularly attractive to Fair visitors.

A Fair newcomer, **Shields Laboratories, Inc.,** came through with a thoroughly interesting display which embraced high-fidelity amplifiers, preamps, speaker enclosures, and a number of audio measuring instruments. Observers were emphatic in their approbation of the components which were shown.

Exceptional attention was created by two new amplifier developments in the exhibit of **Hermon Hosmer Scott, Inc.** One, known as Model 99-A, resembles in appearance and size the "front end" of a



conventional remote-control amplifier, yet is a complete 10-watt amplifier in every respect, including variable record equalization and separate bass and treble controls. Audio characteristics are equal to those of much bulkier counterparts, and the price is remarkably low. The other, known as the Model 121-A Dynaural equalizer-preamplifier, is introduced by Scott as offering "complete control and compensation for any record and record condition, past, present, and future." Not inexpensive, the 121-A is designed strictly for the demanding connoisseur.

A unique preamplifier-equalizer in which the loudness control automatically takes over when bass is boosted, was introduced by **Sonex, Inc.** The loudness control is inactive when the bass control is in zero position. Step-type rolloff and turnover controls give 25 possible equalization curves. The unit gave a thoroughly satisfying demonstration in conjunction with the Sonex ultra-linear power amplifier.

One of the Fair's more inclusive displays of moderate-priced recording equipment was that presented by **Sonocraft Corporation.** Fully justified was Sonocraft's position as one of the leading firms engaged in the sale of sound equipment to schools and colleges.

Something new in pickups—the Titone ceramic cartridge—was given a public initiation by **Sonotone Corporation.** Demonstration brought out the wide frequency range of the unit, as well as the fact that it requires neither a preamplifier nor equalizer. Particularly impressive to visitors was the turnover model in which only the stylus rotates.

Visitors to the **Stephens Manufacturing Corporation** exhibit were deeply impressed by the improved line of Stephens high-fidelity speakers, also by the Stephens "wireless microphone" which permits complete mobility to stage and TV performers. Among the speakers the featured spot was occupied by the Model 628, the finest home reproducer in the Stephens line. Affording full rear horn loading, the 628 is a handsome piece of furniture which may be used either in a corner or against a straight wall.

Of the many items on demonstration in **Stromberg-Carlson Company's** exhibit, a combination tuner-amplifier and the RF-475 coaxial speaker came in for special attention. In its new Type SR-405 self-

contained units, Stromberg-Carlson combines in a single chassis all the features of its popular 10-watt hi-fi amplifier and a high-quality AM-FM tuner with no duplication of controls. The result is an assembly ideal for custom installations. The 15-inch RF-475 speaker contains a 10½-pound Alnico V magnet, which incidental intelligence tells us is energized by one of the largest magnetizers in the world.

One of the more satisfying displays was conducted by a new company—**Tannoy (Canada) Ltd.**, sole distributors for the North American continent of the English-made Tannoy Dual-Concentric loudspeaker. Aside from an impressive demonstration, visitors found great interest in the Tannoy die-cast cone housing which is equipped with international-standard fixing holes. Design of the casting permits elimination of frontal cavity resonance by providing means for mounting the speaker in front of the enclosure, as well as conventionally on the inside when desired.

A new light-weight, inexpensive tape recorder was given its first public showing by **Telectrosonic Corporation.** Easy to operate and distinctive in appearance, the Telectrotape recorder is certain to make its mark in the audio firmament.

There is little to be known about styli which couldn't be learned in the display of **The Tetrad Company.** Excellent photomicrographs were used to show the effects of a worn stylus on records, and to compare the wearing qualities of sapphire and diamond. Also interesting were the color slides showing the various steps in stylus manufacture. Visitors who just happened to bring a stylus along (could there be such?) were offered free microscope and shadowgraph examination.

Never again will those who visited the **Thorens Company** exhibit take for granted the precision of Swiss manufacturing processes. Seldom does one encounter the painstaking care which is so evident in the Thorens line of record changers and single players. History repeated itself in that the feature of the exhibit was the Thorens model which was described in the 1952 version of the present observation as "the changer to end all changers."

One of the Fair's more informative displays was conducted by **Tung-Sol Electric.** Here were shown receiving tubes of many types, including of course the Tung-Sol-developed Type 5881—but more important was the fact that the suite was staffed with competent engineers who were entirely gracious in answering the intricate questions which tubes invariably seem to bring on.

Excellent audio performance, notwithstanding its small size and moderate price, was easily apparent in the new packaged hi-fi phonograph introduced by **Ultrasonic Corporation.** Also impressive was the Ultrasonic Model U-25 speaker system, a compact triangular enclosure for corner installation.

The inherent quality of UTC transformers was well evidenced in the exhibit of **United Transformer Corporation.** Pioneer in the audio industry, UTC has earned a position of unquestioned leadership in the design and manufacture of transformers for high-fidelity equipment of every description.

One of the more pleasant experiences to those of us in the audio industry has been the witnessing of the impressive and well-deserved growth of **University Loudspeakers, Inc.** University was among the trail-blazers in the early days of audio, and today those pioneering efforts are well evidenced in the universal demand for the company's hi-fi speakers and Musicorner enclosures. Although a number of new University items were displayed at the Fair, interest in the familiar Models 6201 and 6200 and the Diffusicone was unsurpassed.

Thousands of descriptive catalogs clutched in the hands of Fair visitors provided eloquent evidence of the welcome accorded **Utah Radio Products Company** on its re-entry into the firmament which is High Fidelity. It doesn't seem like too many years since Utah was among the top kicks in the speaker industry, and this observer joins many other old-timers in wondering where they've been all this time.

Attractively featured in **V-M Corporation's** exhibit was the company's new Model 935HF Triomatic record changer. Designed for use with magnetic cartridges, the 935HF is equipped with a four-pole four-coil motor to reduce hum, and a weighted and balanced turntable to assure constant speed. Appearance of the unit is especially striking. Because of low lateral pressure required to operate the changing mechanism, the 935HF will accommodate pickups with stylus pressure as low as five grams.

Both completed units and components were featured by **Video Corporation of America.** Lest the company name throw you for a loss the "units" were strictly audio, with nothing whatever to do with TV. Exceptional interest was accorded the Model HF-90 table phonograph which employs a six-watt amplifier, a Collaro changer, and two six-inch speakers in a balanced acoustical chamber.

Weathers Industries built an effective exhibit around a record-playing assembly which is being advertised and merchandised as The Debonnaire. It consists of the Weathers FM pickup system and a manual turntable completely assembled and ready to plug into an existing audio system. Also shown was the new Weathers tone arm designed for use where mounting space is limited, and the Weathers pressure gauge for measuring stylus pressure.

A three-speaker table phonograph called the Webcor "Musicale," which includes in its design such high-fidelity features as a loudness control, a five-watt amplifier with extended frequency range and negligible

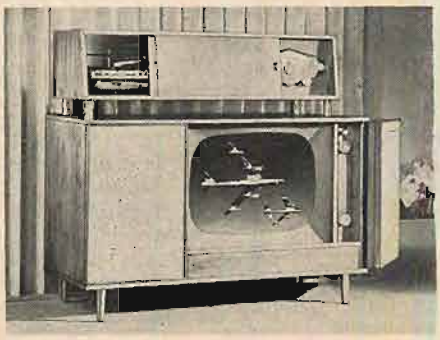
distortion, and a Webcor Diskchanger equipped with a GE magnetic cartridge was starred in the display of **Webster-Chicago Corporation.** Webcor, incidentally, has adopted the triple-speaker idea in a striking new tape recorder which was introduced to a gathering of audio authorities and music critics in New York shortly after the Fair closed.

Belated recognition of the Fair by the recording industry as a propitious spot for the display of high-fidelity records was evidenced by the presence of **Westminster Recording Company** as a prominent exhibitor. It is initiative of this type which, along with the company's magnificent

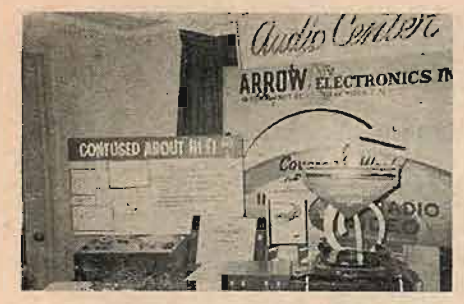
records, is rapidly propelling Westminster into a position of well-deserved supremacy. Incidentaly, the new Westminster hi-fi test record is a humdinger.

The new amplifier circuit known as "Powrtron," introduced to Fair visitors for the first time by **White Sound, Inc.**, left no doubt as to its ability to deliver ultra high fidelity. Demonstrated in conjunction with a White speaker enclosure, the Powrtron amplifier delivered some of the cleanest sound to be heard.

More than gratifying was the attention paid by dyed-in-the-wool audio fans to the handsome new high-fidelity combinations which were displayed by **Zenith Radio Corporation.** All of the Zenith instruments



incorporate the company's exclusive Cobra-Matic Record Changer with built-in stroboscope. In addition to playing all standard 7-, 10-, and 12-inch records automatically, the Cobra-Matic will handle the new "talking book" records which revolve at 16-2/3 rpm. Infinite variable speed control permits operation from 10 to 85 rpm. If any particular Zenith model was singled for more than due share of interest it was the L2894-H, a distinctive radio-phono-TV combination styled in the modern trend, with an acoustically designed bass reflex speaker enclosure.



Left to right: Arrow Electronics, Inc., Asco Sound Corporation, Hudson Radio & Television Corp.

The Distributor-Exhibitors

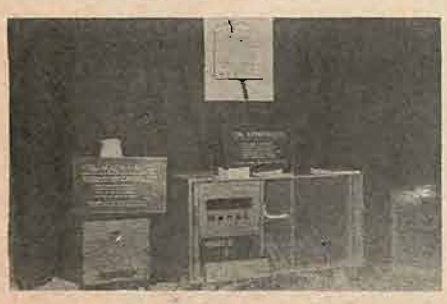
WHAT CAN BE SAID about the distributors who exhibited at the Fair? They all have essentially the same equipment to show, and relatively little can be done to make the same equipment look any different no matter how it is placed.

Instead of extolling the exhibits or the equipment shown by the distributors, we prefer to take this space to extol these important organizations for the work they have to do in carrying the message to the ultimate user of audio equipment. For the distributor and his salesmen are far more than purely a selling organization—each one of the men on the "firing line" has to be a diplomat and an engineer in addition to being a good salesman. People shopping for any product in the audio category are —in most instances—in a field where they are not too familiar, and consequently they have to rely on the sales engineer to advise them on the equipment they need. What may be ideal for the well-to-do buyer with a 30×50 foot living room may not fit the requirements of the small-apartment dweller. The needs of the suburbanite are likely to differ appreciably from those of the city folk, particularly with respect to tuners. So both turn to the distributor's salesman for advice, and it is these men who are the final contact in the long line from manufacturer to consumer.

The consulting room of a professional man could scarcely be more enlightening to the student of human nature than the sales room of an audio distributor. The questions asked, the problems outlined, and the constant weighing of the merits of this unit against that one all add up to an interesting picture of the hi-fi business. The distributor's salesman has, over the past few years, developed into a competent consultant on audio, and we take off our hat to him. He has tact and patience and an enormous fund of information on a complicated subject, and we know of few other types of business in which so much depends on the salesman.

Our sincere compliments, therefore, to this group of men who struggle to make every newcomer to hi-fi a true convert, men who must satisfy every customer as to the performance, cost, and appearance of the merchandise they sell.

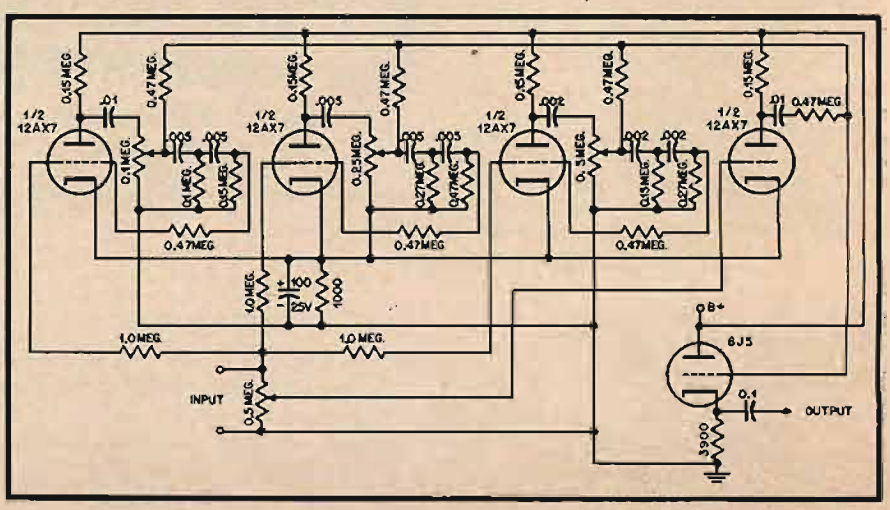
Left to right: Leonard Radio, Inc., Radio-Wire-Television, Inc., Sonocraft Corporation.



Sun Radio & Electronics Co., Inc.

CORRECTED SCHEMATIC

The article, "A Three-Element Bass Control" by Glen Southworth, which appeared in the October issue has been the subject of considerable correspondence from readers who were plagued by the reproduction of the schematic, *Fig.* 5 on page 25. Remade, the cut now shows the decimal points in more readable proportions. AE regrets the inconvenience caused to any of its readers.



Industry Notes ...

The Ampex Corporation has created a wholly-owned subsidiary to be known as the **Ampex Loudspeaker Company,** according to recent announcement of Alexander M. Poniatoff, president. Initial output will consist solely of theatrical speakers to fulfill Ampex commitments to equip theaters with multi-directional sound systems used with 3-D and wide-screen techniques. Ampex speakers are being built under license from **James B. Lansing Sound, Inc.,** under management of Thomas L. Taggart, Ampex comptroller.

Newark Electric Company, 223 W. Madison St., Chicago 6, Ill., is inaugurating its second expansion program within a period of eighteen months. After increasing space from 12 to 25 thousand sq. ft. in May, 1952, Newark added another 10 thousand sq. ft. in November; latest expansion will be used largely to increase sales space and high-fidelity demonstration quarters.

Pentron Corporation, Chicago, is substantially increasing production facilities to meet the demand necessitated by growing sales. According to announcement of Irving Rossman, Pentron president, newly-leased quarters will be devoted essentially to assembly operations.

Reeves Soundcraft Corporation has licensed 20th Century-Fox Film Corporation to use Soundcraft's Magna-Stripe process in the production of release prints for CinemaScope productions, according to Frank B. Rogers, Reeves vice-president. Soundcraft has installed in the Fox Hollywood studios a Magna-Striping machine which is now working full time on the production of mutistriped print stock for a number of CinemaScope productions soon to be released.

Personal Notes—

Arthur Z. Adelman has joined his father's firm, Leon L. Adelman Co., manufacturers' representative, as field representative . . . Entire electronic industry shares bereavement of Burnstein-Applebee, Inc., at recent death of **Joseph A. Burnstein,** company president . . . **C. G. Barker,** former vice-president of Magnecord, Inc., has been named distribution manager of The National Company, Malden, Mass., **Chris J. Witting,** manager of the Dumont Television Network, has been named president of Westinghouse Radio Stations, Inc., effective January 1 . . . **E. W. Nielsen** is new president of Best Manufacturing Co., Inc., Irvington, N. J. Brook Electronics, Inc., announces the appointment of **Evelyn J. Horne** to its advertising department.

A MONTHLY SUMMARY of product developments and price changes of radio electronic-television parts and equipment, supplied by United Catalog Publishers, Inc., 110 Lafayette Street, New York City, publishers of Radio's Master.

These REPORTS will keep you up-to-date in this ever-changing industry. They will also help you to buy and specify to best advantage. A complete description of most products will be found in the Official Buying Guide, Radio's Master—available through local radio parts wholesalers.

RCA—Added "Radiotron Designer's Handbook," 4th Edition, at $7.00 user price.
RIDER, JOHN F.—Added No. 148 "Guide to Audio Reproduction" at $3.50 net.
RINEHART BOOKS—Added "High Fidelity Techniques" at $7.50 net.
ACRO PRODUCTS—Added Model TO-330 Transformer at $39.75 net.
AMPEX ELECTRIC—Increased prices on the component parts of the Model 450 Audio Magnetic Tape Reproducer series.
BROCINER ELECTRONICS—Added model 4W wall horn at $420.00 consumer price.
BRUSH ELECTRONICS—Added model BK455P "Soundmirror" high-fidelity tape recorder at $289.50 list.
FAIRCHILD RECORDING — Added model 828 automatic spiralling attachment at $570.00 net; model 829 vacuum chip system at $150.00 net.
GENERAL ELECTRIC—Added model A1-200 preamplifier control unit at $57.95 net; model A1-300 10-watt amplifier at $47.75 net; model A1-400 12-in. dual coaxial speaker at $41.95 net; model A1-406 loudspeaker enclosures, blonde at $59.95 net, mahogany at $59.95 net, unfinished at $50.37 net.
KINGDOM PRODUCTS—Added model LP65 2½-in. tweeter at $8.50 user price; model LP215 9-in. loudspeaker at $22.50 user price.
LANSING SOUND, JAMES B.—Added model 150-4B 15-in. low-frequency horn driver unit at $114.00 net.
NATIONAL HOLLYWOOD—Discontinued their sapphire phono needle series.
ORRADIO INDUSTRIES—Increased price on "Irish" tape 195RPA, plastic base, 1200 ft. on plastic or metal reel to $3.75 net.
PENTRON—Discontinued model PB-1 tape player.

FOR SALE: Fisher Master Audio Control, model 50-C, used less than 40 hours. $55. Call WA 7-8669 (N. Y.) or write Box CD-4, AUDIO ENGINEERING.

SACRIFICE: Brand-new Altec 604C in beautiful Unimode bass-reflex cabinet. Consumer's net $300, selling for $200. Reice Hamel, 325 Midwood Street, Brooklyn 25, N. Y. PR 2-4563.

FOR SALE: (Phila. area only) Presto 15-G turntable in wooden cabinet; Proctor Soundex multispeed turntable; Proctor and Pickering arms. $100 takes all. Call GR 3-0948.

BROWNING RJ-12C AM-FM tuner with power supply, $105. Apt. 3M, 34-35 76th St., Jackson Heights, N. Y. IL 7-8649.

CANADIANS—Two complete systems for sale, including Concertone recorder, Wenthers pickup, Rek-O-Kut turntable. Write for details. L. K. Crabtree, 765 118th St., Shawinigan South, Quebec.

WANTED: Experienced efficient, dependable radio and Hammond Organ service man, to take over our shop and operate it as own business. $2000 capital required. Will finance a portion if necessary. Must have good references as to character, dependability, and credit. A highly profitable opportunity for the right man. Previous Hammond organ experience not required if you have a good working knowledge of electronics. TERRY'S MUSIC STORE, Inc., 309 Main St., La Crosse, Wis.

BRUSH BK-401 tape recorder chassis. Tape transport, recording amplifier, and playback preamplifier only. Recently checked by Brush dealer, $65. Arthur Bunker, 4947 Ward Parkway, Kansas City, Missouri.

CLASSIFIED

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WILLIAMSON amplifiers—buy direct from factory and save 50%. Prices start at $56. Send postcard for list. Long Island Sound Co., 19 Bennett Place, Amityville, N. Y.

AUDIOPHILES wanted for part or full time work. Technical or secretarial experience desirable. Location: north suburban Philadelphia. Send resume of education and experience to Box CD-1, AUDIO ENGINEERING.

PRESTO Y-3 recorder in new condition, used less than 15 hours, 112 and 224 lines, 1D cutter, G.E. VR playback. $400. C. F. Craig, 3802 Grand Ave., Omaha 11, Nebr.

3-WAY Klipschorn system built by Klipschorn sales engineer. Klipsch-type components. Seller will provide A-B against commercial Klipschorn. $345. TWining 6-0916, Forest Hills, N. Y.

FOR SALE: Presto 90B recording amplifier, guaranteed excellent condition, $285; Gray 603 Equalizer, $30. Louis Brown, 2217 Alexander, Waco, Texas.

FOR SALE: Lowther PW1 corner horn, $95; Lowther-Voigt PM2 driver also available. Royal II type enclosure, with Jensen 15-in. woofer, Stephens h.f. driver, Hoodwin 8HD horn, 800-cps network, complete, $175; new Pilot PA-911 preamp, $22. All perfect condition. FOB. Hovland, 151 Hartford Tnpk., Hamden, Conn.

KITS ASSEMBLED: designate tuner, amplifier, test instrument, add 25%. Bridges Electronics, Randolph Rd., Rockville, Md.

CRAFTSMAN RC-10 Tuner, like new, $95. E. D. Dupre, 16-A Glendale St., Worcester, Mass.

WANTED: Used FM tuner, also tape recorder. Box CD-2, AUDIO ENGINEERING.

WRITE FOR FREE TRIAL and data on our "Battleship Built" Williamson Amplifier. Nicely Associates, Kenton, Ohio.

SELL: Altec 604C, McIntosh C104A, University 4408, make offer. C. B. Parkinson, 431 Encinitas, Monrovia, Calif.

UNIQUE BARGAIN. New, guaranteed, in manufacturers' cartons: Browning RV31, $88; Bell 2200, with pilot light, $89; Wharfedale Super-12, $58; R-J floor model, 12-in. enclosure, unstained, $36; Garrard RC-80 with base, $38; G.E. Golden Treasure, certified flawless diamond and sapphire, $19.50. As complete system, rock-bottom price $315. Box CD-3, AUDIO ENGINEERING.

FOR SALE: 5-cu. ft. speaker cabinet, $10; 3-cu. ft. speaker cabinet, $8; Meissner SC FM tuner, $38; Miller 585 tubeless tuner, $7; Jensen P8R, ST-169, $6; Triplett 666H volt-ohmmeter with case, $12; two Western Electric 0–200 microammeters, $18; 75 assorted tubes, 10% off net. T. M. Olsen, 745 E. 242nd St., Bronx 70, N. Y.

TRADE your unwanted electronics equipment for finest new audio components at AUDIO LABORATORIES, 2111 Camden Ave., Los Angeles, Calif.

FOR SALE: Magnecorder PT6-M, PT6-J, PT6-AH, extra equalizer, extra twin-track head, 2 carrying cases, $400. Excellent condition. Associated Recording Studios, 1625 Broadway, New York 19, N. Y. CIrcle 5-7351.

FOR SALE: Concertone 1401D and 1401S tape recorders, brand new, full warranty, usual net $345, unbelievable special, $260; Nationally advertised Williamson Amplifiers (not kits—fully assembled, tested) featuring Peerless transformers, KT-66 output tubes, usual net $99.95, our special $75; BOZAK 3-way system, demonstrator, including 12-in. woofer, midrange, two tweeters, dividing network, 8-cu. ft. sealed enclosure, Bozak endorsed, usually $225, close out $165; many other interesting buys in new and second hand equipment, generous trade-ins allowed. Write for details to: Audio Bargain Center, Box 12, Fleetwood Station, Mt. Vernon, N. Y.

VIRGIN Presto Thermostyli. Box 101, St. Albans, N. Y.

Audio Engineering—1953
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THESE ARE THE

REASONS

WHY DAVEN IS THE LEADER IN THE AUDIO ATTENUATOR FIELD

LA-130 Series,
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30 Steps, 1¾ Diameter

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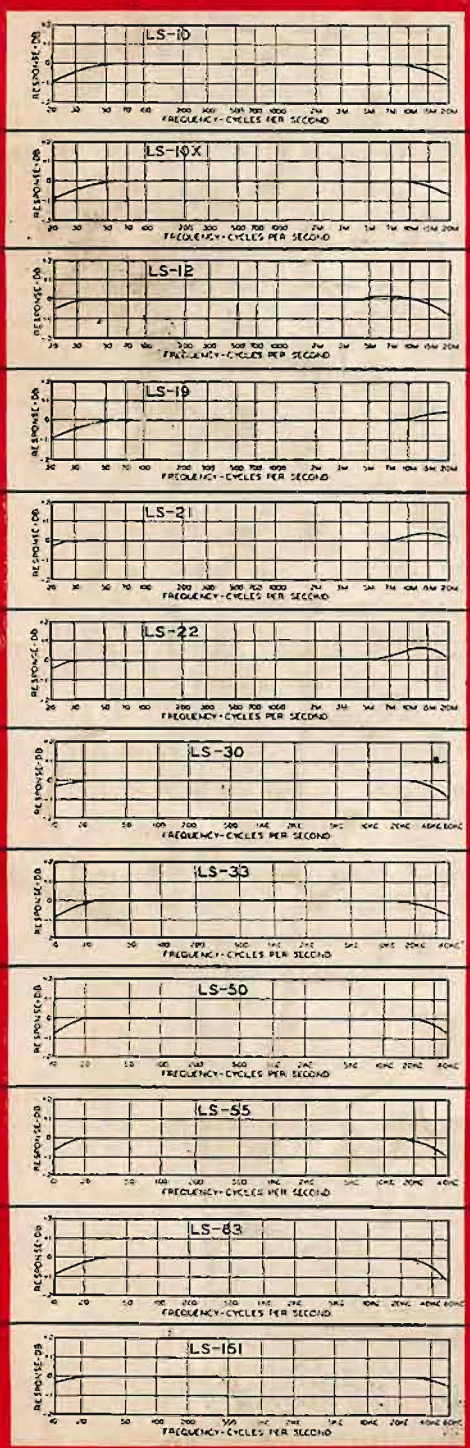
The ever increasing use of wide range equipment for broadcast service has reached the point where the major limiting factor is the frequency range of the transformers employed. UTC Linear Standard components represent the closest approach to the ideal transformer from the standpoint of uniform frequency response, low wave form distortion, high efficiency, thorough shielding, and dependability. Typical LS units are described below.



INPUT TRANSFORMERS

Case Size	LS-1	LS-2
Length	3⅛"	4 7/16"
Width	2⅝"	3½"
Height	3¼"	4 3/16"

Type No.	Application	Primary Impedance	Secondary Impedance	± 1 db from	Max.† Level	Relative* hum	Unbal. DC in prim'y	Case No.	List Price
LS-10	Low impedance mike, pickup, or multiple line to grid	50, 125/150, 200, 250, 333, 500/600 ohms	60,000 ohms in two sections	20-20,000	+10 DB	−74 DB	.5 MA	LS-1	$25.00
LS-10X	As above	As above	50,000 ohms	20-20,000	+10 DB	−92 DB-Q	.5 MA	LS-1	35.00
LS-12	Low impedance mike, pickup, or multiple line to push pull grids	50, 125/150, 200, 250, 333, 500/600 ohms	120,000 ohms overall, in two sections	20-20,000	+10 DB	−74 DB	.5 MA	LS-1	28.00
LS-12X	As above	As above	80,000 ohms overall, split	20-20,000	+10 DB	−92 DB-Q	.5 MA	LS-1	35.00
LS-15X	Three isolated lines or pads to one or two grids	30, 50, 200, 250 ohms each primary	60,000 ohms overall, in two sections	20-20,000	+10 DB	−92 DB-Q	.5 MA	LS-1	37.00

INTERSTAGE AND MATCHING TRANSFORMERS

Type No.	Application	Primary Impedance	Secondary Impedance	Response	Max.† Level	Relative* hum	Unbal. DC in prim'y	Case No.	List Price
LS-19	Single plate to push pull grids like 2A3, 6L6, 300A. Split secondary	15,000 ohms	95,000 ohms; 1.25:1 each side	± 1 db 20-20,000	+12 DB	−50 DB	0 MA	LS-1	$26.00
LS-21	Single plate to push pull grids. Split pri. and sec.	15,000 ohms	135,000 ohms; 3:1 overall	± 1 db 20-20,000	+10 DB	−74 DB	0 MA	LS-1	26.00
LS-25	Push pull plates to push pull grids. Medium level. Split primary and sec.	30,000 ohms plate to plate	50,000 ohms; turn ratio 1.3:1 overall	± 1 db 20-20,000	+15 DB	−74 DB	1 MA	LS-1	32.00
LS-30	Mixing, low impedance mike, pickup, or multiple line to multiple line	50, 125/150, 200, 250, 333, 500/600 ohms	50, 125/150, 200, 250, 333, 500/600 ohms	± 1 db 20-20,000	+15 DB	−74 DB	.5 MA	LS-1	26.00
LS-33	High level line matching	1.2, 2.5, 5, 7.5 10, 15, 20, 30, 50 125, 200, 250, 333, 500/600	50, 125, 200, 250, 333, 500/600 ohms	± .2 db 20-20,000	15 watts			LS-2	30.00

OUTPUT TRANSFORMERS

Type No.	Application	Primary Impedance	Secondary Impedance	Response	Max.† Level	Relative* hum	Unbal. DC in prim'y	Case No.	List Price
LS-50	Single plate to multiple line	15,000 ohms	50, 125/150, 200, 250, 333, 500/600	± 1 db 20-20,000	+15 DB	−74 DB	0 MA	LS-1	$25.00
LS-52	Push pull 245, 250, 6V6 or 245 A prime	8,000 ohms	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	± .2 db 25-20,000	15 watts			LS-2	35.00
LS-55	Push pull 2A3's, 6A5G's, 300A's, 275A's, 6A3's, 6L6's, 6AS7G	5,000 ohms plate to plate and 3,000 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	± .2 db 25-20,000	20 watts			LS-2	35.00
LS-63	Push pull 6F6, class B 46's, 6AS7G, 807-TR, 1614-TR	10,000 ohms plate to plate and 6,000 ohms plate to plate	30, 20, 15, 10, 7.5, 5, 2.5, 1.2	± .2 db 25-20,000	15 watts			LS-2	25.00
LS-151	Bridging from 50 to 500 ohm line to line	16,000 ohms, bridging	50, 125/150, 200, 250, 333, 500/600	± 1 db 15-30,000	+18 DB	−74 DB	1 MA	LS-1	27.00

The values of unbalanced DC shown will effect approximately 1.5 DB loss at 30 cycles.
* Comparison of hum balanced unit with shielding to normal uncased type. Q Multiple alloy magnetic shield.
† 6 MW as ODB reference.

* UTC LINEAR STANDARD transformers are the ONLY audio units with a GUARANTEED uniform response... ± 1 DB from 20 to 20,000 cycles.

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