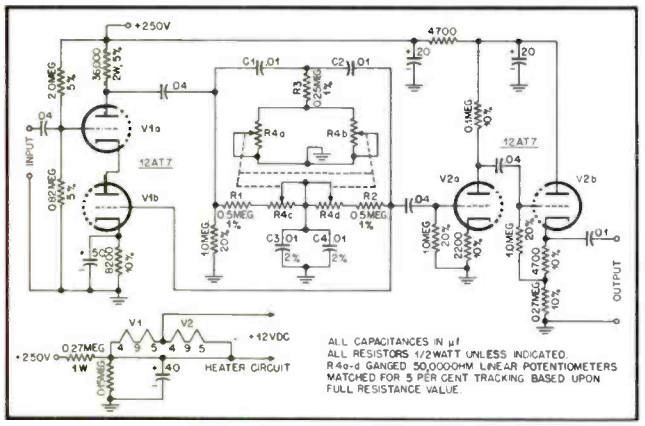
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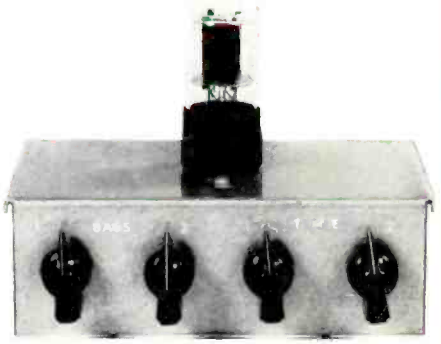
ENGINEERING MUSIC SOUND REPRODUCTION

NOVEMBER, 1954

50c



As low-frequency reproduction is improved, rumble becomes more and more of a problem to those who demand the utmost in quality. One author uses this circuit to eliminate rumble, and describes it in his article on page 32.



Audio equipment often performs better with resonant circuits, but components are expensive. R-C circuits can achieve equivalent results. See page 20.

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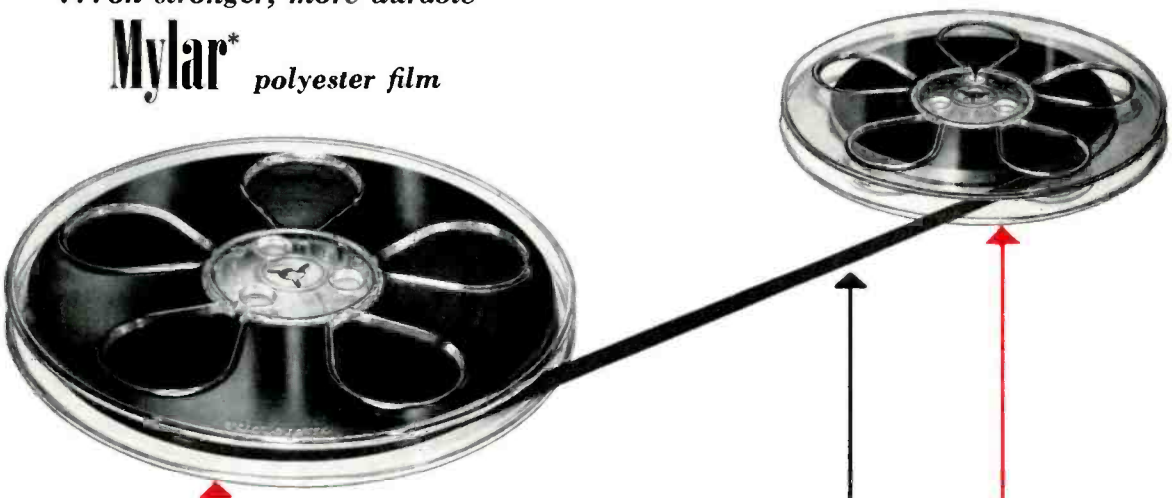
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AUDIO PATENTS

RICHARD H. DORF*

A NEW BOOK has come to me in the last few weeks, one that I found extremely interesting and believe many AUDIO readers will, too. It is the second edition of "Inventions and Their Protection," by George V. Woodling, engineer and patent attorney, and it is published by Matthew Bender & Co., Inc., of Albany, N. Y.

While Bender is a law publisher and few of its tomes normally find their way inside engineering premises, this book is written specifically for the layman (lawyerly speaking). This column is not meant for book reviews, but reading Woodring's work gives rise to many thoughts about the tie-ups that ought to, and too often don't, exist between people who do any kind of original technical work and those who handle patent procedures. So this short article will express a few of them, using the book as a springboard.

Nature of a Patent

An interesting concept that Mr. Woodring points out, to begin with, is that a patent is a negative right more than a positive one. In other words, it entitles you to prevent anyone else from making, using, or selling what you have patented, but it does not give you the right to make, use, and sell. That latter—the right of everybody to make, use, and sell products—is conferred by the common law. In the absence of any other laws, that would permit anybody to use what you have invented. However, the U. S. constitution and various statutes promulgated thereunder do give you the right to prevent others from using what you have invented and patented.

The law does not, incidentally, prohibit anyone from using, making, or selling a patented article. All it does is give the inventor (or others under him) the right to sue infringers in civil courts to halt infringement; the government itself will take no action.

Many people reading a patent copy obtained from Washington are under the impression that what is covered is the device, process, or article described in the specifications and drawings. Nothing could be further from the truth: it is the numbered claims at the end which define what is covered. I remember reading a patent a few months ago covering an AM radio receiver designed for unusually high fidelity. The scheme was this. Two detectors were used, one tuned directly to the center of the signal and the other tuned away from center, on one of the sidebands. The bass was supposed to come from the first of these detectors and the treble from the second.

What apparently happened was that the "inventor" tuned a radio one day and noticed that when you tune away from the center of the carrier (remember this is AM) the bass dropped out and the sound was shrill. Now, you and I know that this is because as you tune farther from center, the passband of the detector encompasses more of the high-audio-frequency sidebands and fewer of the low-frequency sidebands; since it is the sidebands which carry the energy, the result is no bass. However (this is all guesswork, but I can see what else could have happened) the inventor figured that the shrillness was really some treble sounds which were not heard with conventional tuning, and decided to use two detectors, combining the audio later in the receiver, resulting in extended audio range.

I read through this patent with growing amazement, wondering how the patent office could allow such a thing to go through. And then on the last page, after the thorough, detailed, and glowing description, I had my answer. Exactly one claim had been allowed—for a receiver with two detectors!

In a more serious vein, however, the drawing of claims is really the job the patent attorney is paid for, for they determine what the coverage will be. However, no attorney is ever as familiar with an inventor's idea as the inventor is, and so, as Mr. Woodring points out in his excellent chapter, "Making Your Patents Pay," it is up to the inventor to cooperate both before and after an application is made.

Most inventions these days are made to solve some specific problem, and when the idea that will solve that problem is evolved, the inventor often feels his job is done. To show how wrong such an attitude is Mr. Woodring cites a simple hypothetical case which supposes that Inventor A has come up with a new invention which we, being in the 20th century, know as the wheel. In his first claim submitted to the patent office with the specification of the best embodiment he claims a circular body with a central axis, because that is what he needed.

A few weeks later, however, our inventor hears through the grapevine that a competing company is using a cam operating from a wheel with an eccentric axis—a hole other than in the middle. So, mindful of his duties, he goes back to the patent attorney and tells him. After some thought the attorney drafts a second claim which is the same as the first except that the wheel is described as a circular body with an axis, leaving out the word "central." This is legitimate, since it certainly includes his original creation, the wheel with the central axis (remembering that nobody had previously invented any kind of wheel).

That night our inventor can't sleep and his insomnia pays off in the conception of a wheel which isn't circular at all—which can be used as a cam with all sorts of peculiar motions. So back again he goes to the attorney, who promptly writes a third claim

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

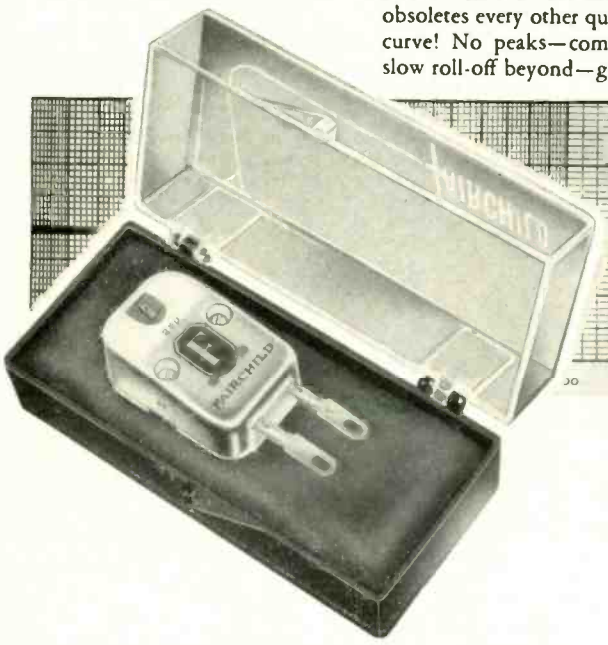
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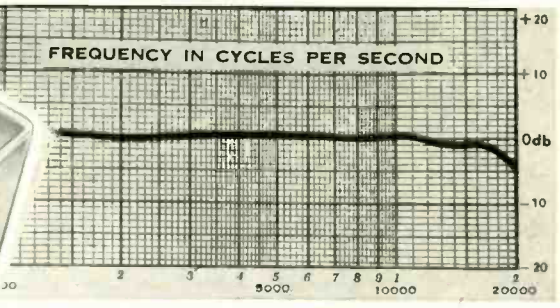
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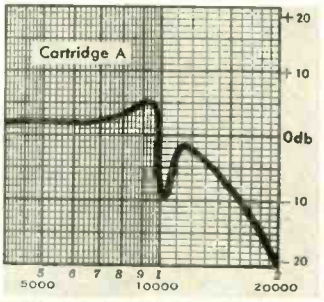
An unparalleled achievement in high fidelity cartridge design and performance

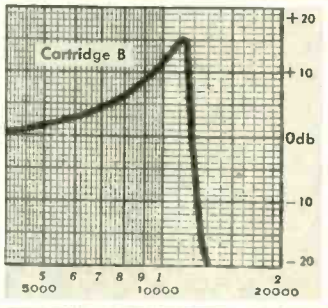
From Fairchild now comes a development so startling that it virtually obsoletes every other quality cartridge on the market. Look at the response curve! No peaks—completely uniform response to 17,000 cycles—and slow roll-off beyond—giving smooth natural sound!

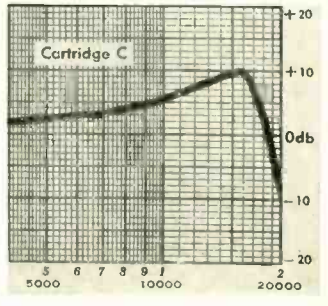




Then compare the Fairchild 220 to these other well-known cartridges. Peaks and jagged response curves mean rough sound—unnatural harshness even in the mid-range.

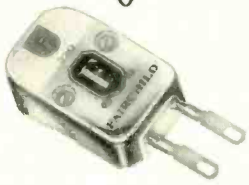






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covering an annular body with an axis, still legitimate because it, too, includes his original wheel. This new claim now covers any annular piece which has an axis about which it can revolve, and is actually the kind of broad claim that should have been made in the first place.

Two important things are brought out by this story. First, the inventor should always keep an eye out and a mind open for small variations of his original idea that can still be claimed while the patent application is being processed.

Second, and still more important, before an application is ever submitted, the inventor and his attorney should try to think up every possible variation on the basic idea and include it in the claims. These thoughts can be based, not only on the device at hand, but also on probable future developments and on related devices. And they *must* be based also on what a competitor may do to try getting around the claims. Plug the loopholes! I remember that when claims were drawn for the little game I described in these pages a short time ago, my whole idea was to make an electrical game. But my attorney had me go home and draw up plans for doing the same thing mechanically, just to cover the possibility that someone might use this means to get around my basic idea.

Almost every patent includes phraseology at the end of the specification to the effect that while one embodiment has been shown, the inventor does not mean thereby to limit his claims to that embodiment and that other ways of achieving the same result are within the purview of the patent. This language has very little real significance. It is sometimes used as a substitute for the additional brainwork that would be required to evolve the other ways and protect them specifically, but it is a poor substitute.

It is also poor policy to be any more specific than necessary. If it happens, for instance, that that operation of a certain new device depends on a Thyrite resistor in the inventor's model, it is certainly not a good idea to mention Thyrite resistors in the claims; the proper procedure would be to specify "nonlinear" resistors. And if the invention could be made to work with, say, voltage-sensitive capacitors, then it is better to cite "nonlinear elements" or something of the sort. If you specify one type of component, then surely someone will use another type and you will have no comeback.

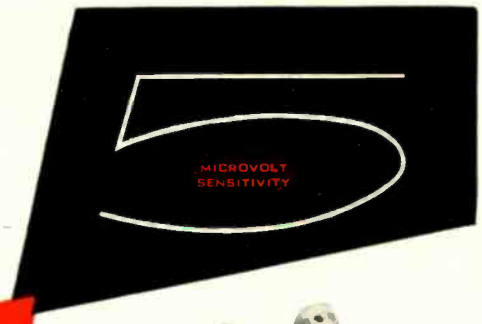
To illustrate this point, Mr. Woodring cites the patent on nonflickering neon signs which cites an electrostatic shield. This patent might have earned millions in royalties, but that one word "electrostatic" robbed it of all value because competitors easily designed around it, using, I presume, shields of natures other than electrostatic in the accepted technical meaning of the term.

One last warning at this time, not from the book but from experience. Find an attorney who is thoroughly familiar with the field of the invention. The best mechanical-engineer-attorney can make a mistake of omission in an electronic patent application, simply because he has no way of knowing what to look for and what to mention and not mention in his claims other than what the legally ignorant inventor has told him. It may be hard to find an attorney expert in electronics, but don't let one who isn't handle your application on that new circuit!

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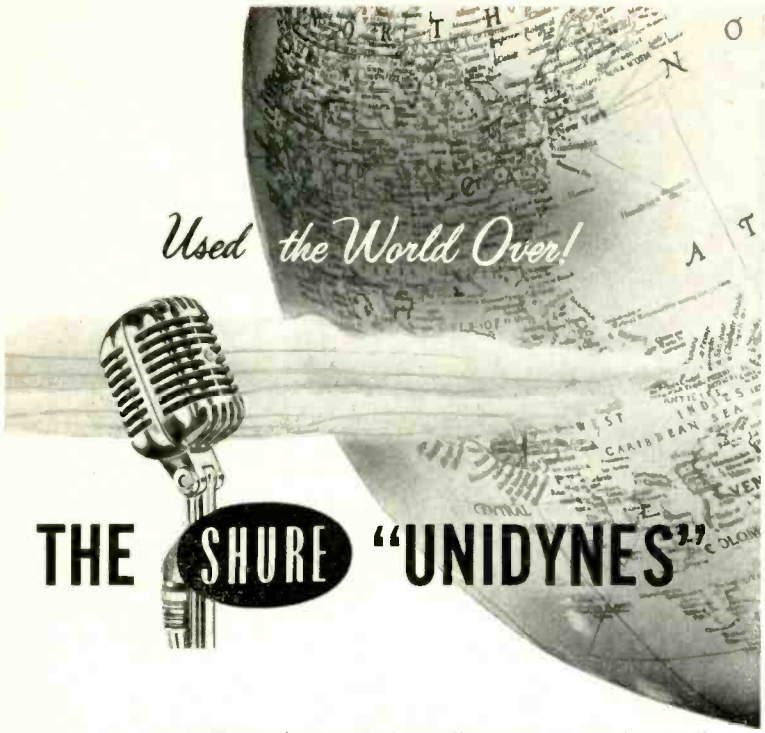
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NEW LITERATURE

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● **Hycor Company, Inc.,** 11423 Vanowen St., North Hollywood, Calif., supplies complete technical data, including general characteristics, specification charts, and a listing of standard case styles for Hycor toroid coils in a recently-published 4-page folder. Available in three forms—uncased, cased, and encapsulated—Hycor toroids meet a wide variety of applications in the field of audio engineering. Copy will be mailed on request.

● **Radio Shack Corporation,** 167 Washington St., Boston 8, Mass., includes a 32-page rotogravure section devoted exclusively to high-fidelity custom music systems in its new 1954 mail-order catalog of electronic parts. Listing more than 30,000 radio, TV, and electronic parts in its 224 pages, the new catalog has a manufacturers index on the front cover, an 18-category thumb index, and an extensive product listing to facilitate ordering. Copy will be mailed free on request. A separate hi-fi section which is titled "music in your home" is also available for those whose interest is mainly in audio equipment. Ask for Catalog 55-HF.

● **Langevin Manufacturing Corporation,** 37 W. 65th St., New York 23, N. Y., introduces its new high-fidelity amplifying equipment for home use in a 4-page illustrated folder which will be mailed on request. Long known as a principal supplier of audio equipment to professional sound studios, Langevin is entering the home equipment field with a remote-control amplifier which features wide frequency response and remarkably low distortion.

● **Sola Electric Co.,** 4633 W. 16th St., Chicago 50, Ill., has published one of the most intelligently-prepared pieces of industrial literature ever to cross this desk in a new 20-page book titled "The Sola Constant Voltage Transformer—Theory of Design and Operation." Written for electrical engineers and others interested in the underlying electro-magnetic relations of the Sola constant-voltage principle, the book contains schematic diagrams, vector diagrams, performance curves, and photographs illustrating typical assemblies. Available on request, this publication is indeed a criterion in every respect.

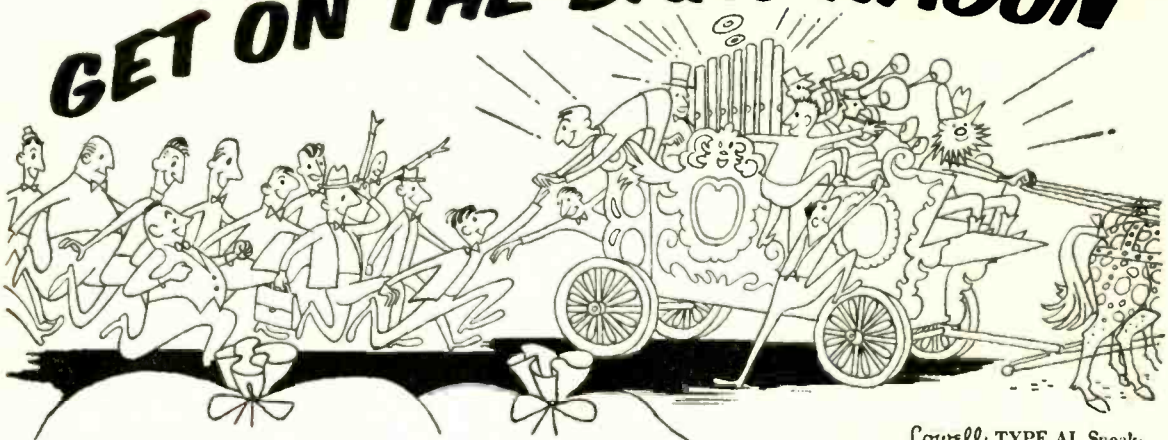
● **Insulation Manufacturers Corporation,** 565 Washington Blvd., Chicago 6, Ill., in a new 20-page illustrated catalog, covers revised and added technical data on Permacel pressure-sensitive electrical tapes, as well as non-electrical tapes marketed under the Permacel and Texcel trade names. This booklet is highly recommended for users of pressure-sensitive tape in any form. Requests for copy should be addressed in care of the Publications Department.

● **International Rectifier Corporation,** 1521 Grand Ave., El Segundo, Calif., in newly-published Bulletin GD-1A lists ratings and physical specifications of the entire line of IRC germanium diodes. Included in the bulletin is a complete replacement guide showing which IRC diodes may be used in place of various RETMA types, also complete specifications for the new IRC "Red Hot" diodes for 100° C. applications. Available on request.

● **James B. Lansing Sound, Inc.,** 2439 Fletcher Drive, Los Angeles 39, Calif., is making available at a cost of one dollar illustrations of four early-day musical instruments which have been used in the company's recent advertising. The 8" x 10" black-and-white illustrations are mounted on 11" x 17" pebble-finish cards, suitable for framing. Subjects in the initial series include a pandurina, colascione, chitaronne, and lyre guitar.

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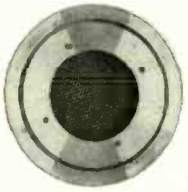
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LETTERS

Sound Diffusion

SIR:

In the August issue, M. Rettinger contributed an article on the subject of "Sound Diffusion in Rooms" on which some comment may be of interest. He quoted my article on an "Empirical Acoustic Criterion" and expressed the opinion that the method of measuring the irregularity in decay of sound described therein may be of use in the assessment of diffusion. The "decay irregularity factor" obtained and designated by "D" was originally developed as a measure of diffusion and experiments which were carried out some time ago indicate that it is better than others so far used. The following table shows an interesting comparision of diffusers by two methods, frequency irregularity and decay irregularity.

	Frequency Irregularity "F.I." db/cps	Decay Irregularity "D" db
No diffusers	6.7	3.6
Hemi-cylindrical diffusers	5.6	3.4
Rectangular diffusers	5.1	2.6

In this experiment, the number of cylindrical and rectangular diffusers was the same but the volume of the latter was slightly less than the volume of the former.

Small changes of reverberation time due to the introduction of the diffusers into the room have to be taken into account when assessing the significance of these results. It was found, under the conditions of the experiment, that the frequency irregularity increased in proportion to the reverberation time of the room; but the results for a large number of rooms show only a small increase of "D" with reverberation time.

When this has been taken into account, the reduction of both "F.I." and "D" is a significant indication that the rectangular shapes increase the diffusion, whereas the reductions found with the hemi-cylinders could have been due mainly to the decrease in reverberation time.

It has also been found by controlled experiment that the presence of diffusers will increase the efficiency of absorbers in the room. The hemi-cylindrical diffusers referred to above produced an increase of 10 per cent in the absorption coefficient of 1-in. deep porous absorbers at frequencies above 700 cps.

During the investigation of diffusion by means of decay irregularity, the correlation between the subjective assessments of rooms and "D" was poor. It has so far proved impossible subjectively to separate the effects of reverberation time and diffusion and it was for this reason that the objective empirical criterion was devised in an endeavour to combine the objective measurements. So far we have not been able to establish a reliable subjective basis for objective measurements of diffusion alone.

T. SOMERVILLE,
The British Broadcasting Corporation
Broadcasting House,
London, W.1, England.

New Tube?

SIR:

I would like to campaign for the introduction of a new power triode. A variety of pentode and beam tubes is available for almost any type of home music system, but the 2A3 power triode, developed over 20 years ago, appears to be the latest triode to receive wide employment in low-power amplifiers, except for its electrically similar types (6A3, 6B4G, and 6A5G).

Several of the pentode and beam tubes connected as triodes are widely employed, but at a sacrifice of maximum power output as compared to that obtainable with the pentode connection. With triode connection, reasonable output in class A usually requires that high plate voltage be used. In many cases, this will cause some rating(s) to be exceeded.

The 2A3 family of tubes will give good output in class A at moderate plate voltage because of the low plate resistance, but this is accompanied by low amplification factor, making necessary a large a.c. grid drive voltage. The more recently introduced 6AS7G family is an excellent example of very low plate resistance and very low mu. The latter is so low that the grid must often be excited through a transformer.

As a starting point, the specifications for a modern receiving-type power triode might look something like these:

Maximum Ratings:	
Plate Voltage	500 max. volts
Plate Dissipation	20 max. watts
CLASS A_1 AMPLIFIER (Push Pull)	
Typical Operation:	
Plate Voltage	350 volts
Grid Voltage	−38 volts
Peak a.f. grid-to Grid Voltage	76 volts
Zero Signal Plate Current	114 ma
Plate Resistance	800 ohms
Amplification Factor	8
Transconductance	10,000 μmhos
Load Resistance	9000 ohms
Maximum Power Output	14.8 watts

Several modern tubes have some of the characteristics to be desired in a power triode, but other of the characteristics or ratings rule out their employment. It may be possible that some slight design modification(s) would render them useful as power triodes. Two examples are types 6AH4GT and 6BL7GT.

The 6AH4GT, a single triode, has a mu of 8, R_p of 1780 ohms, max. plate dissipation of 7.5 watts, and E_{bb} max. 500. The characteristics and maximum dissipation rating of two tubes in parallel, but in one envelop, would fulfill the needs, though a slightly higher plate dissipation rating would be still better.

The 6BL7, a dual triode, has a mu of 15, R_p of 2150 ohms, max. plate dissipation of 10 watts per section but only 12 watts total for both, and E_{bb} max. 500. Parallel connection of this tube yields good characteristics except for the low plate dissipation. Perhaps a larger envelop would permit a combined rating of 20 watts, but the relatively high amplification factor is a redeeming feature.

There exist numerous other types to which seemingly possible design modifications can be made to make them desirable as power triodes. Among them are some pentode and beam tetrode types which would require that only the maximum plate dissipation and/or plate voltage ratings be increased for triode service.

Perhaps a market survey would show sales possibilities for a new power triode tube, moderately priced.

J. L. MARKWALTER, JR.,
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(*Continued on page 68*)

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ABOUT MUSIC

HAROLD LAWRENCE*

Richard Strauss—Vintage Years (1942-1949)

THE STRONGEST IMPACT of Richard Strauss on the musical scene took place between the years 1889–1911. Beginning with *Don Juan* which established the composer's reputation in seventeen minutes on the evening of January 11, 1889, Strauss reigned supreme in his native Germany and exerted a powerful influence on European composers for more than twenty-two years, during which time he turned out his most popular scores: the tone poems, *Don Juan, Death and Transfiguration* (1889), *Till Eulenspiegel* (1895), *Also Sprach Zarathustra* (1896), *Don Quixote* (1897), and *Ein Heldenleben* (1898), and the operas, *Salome* (1905), *Elektra* (1909), and *Der Rosenkavalier* (1911). Following World War I, the "thunderbolt of Strauss," as Sir Thomas Beecham put it, "no longer had the power to terrify." Next to works by Stravinsky, Schönberg, Hindemith, Honegger, and Prokofiev, the rasping 'dissonances' of *Ein Heldenleben* or the bitonal conflicts in *Also Sprach Zarathustra* lost their bite and somehow seemed rather tame. Side by side with the *Rite of Spring*, the orchestral complexities of *Till Eulenspiegel* appeared almost as simple as Donizetti's accompaniment to the Sextet from *Lucia*. But more important, the new generation had rejected nineteenth-century Romantic concepts of which Strauss—now that Mahler was dead—was regarded as the last great epigone.

In the postwar era, a barrage of criticism was leveled at Strauss by contemporary composers. Strauss was indicted on several counts: (1) his orchestration was overelaborate; (2) his programmatic ideas were obvious, often non-musical (e.g., the wind machine in *Don Quixote*, the trapdoor in *Till*, etc.), and, in the case of *Ein Heldenleben*, overbearingly egotistical (Strauss pictured himself here as a combination of St. George and Christ battling a multitude of loathsome, pygmy-sized adversaries); (3) gushy sentimentality; and (4) artificiality. Even his admirers found fault with his output, claiming that he was repeating himself on an infinitely less expressive plane. The majority opinion was that Strauss had shot his bolt. He was apparently content to reminisce rather than keep up with contemporary musical development. Thus in little more than a decade, Strauss the "revolutionary" had come to be regarded as something of an anachronism.

Applied to certain of his compositions, the charge would, on the surface, seem to have some justification. In the tenth and last of Strauss' symphonic poems, the *Alpine Symphony* (1915); in the opera, *Arabella* (1933); and in the ballet, *Schlagobers* (to cite examples in three different forms of composition), the inspiration seems to lack the fresh and exciting qualities that characterize his earlier scores. Perhaps the thrice familiar Strauss pieces are too much with us to allow a fair appraisal. Certainly the general public has not been given the full opportunity to acquaint itself with this between-wars body of work.

Much of the music Strauss wrote during and after World War II, however, is available to us now on discs. Of these last works, the LP catalogue lists the *Concerto for Oboe* (1945), *Metamorphosen* (1945), the final scene from *Capriccio* (1942), *Four Last Songs* (1946–8), *Duet Concertino* (1947), and two *Wind Sonatinas* (1943). For the music lover who has been brought up on a diet of early Strauss, the products of the Bavarian composer's old age might seem frail and colorless by comparison. But this impression is quickly dissipated. Apart from the undeniable technical mastery we expect from any Strauss score, some hitherto new elements pervade these works. There is a simplicity, a preference for smaller, more intimate instrumental groups, a compelling sincerity of expression and freedom from bombast and sensationalism.

Capriccio, Strauss' fifteenth and last opera, was composed in 1942 on a libretto by Clemens Krauss. Intended for an intimate theatre audience, this "conversation piece in music" is hardly designed to appeal to the public on a large scale. Its plot is actually a "disguised" argument over the respective merits of words and music in the theatre. The story takes place in 1775 in a castle outside Paris filled with personages who seem to come out of a painting by Fragonard. The leading character is a beautiful Countess to whom a young composer and a young poet are paying court. The poet writes his love a sonnet and the musician sets it to music. The Countess must then choose one of the suitors, her decision to be based on both the man and his artistic case. *Capriccio* ends on a question mark as the Countess appears to leave the issue unresolved. But, as Noel Strauss, music critic of *The New York Times*, pointed out, "[she] cannot choose between the lovers because she is aware that, separately, neither of them satisfies her esthetic nature. . . . Since she knows that poetry and music must be on an equal footing to 'storm her

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

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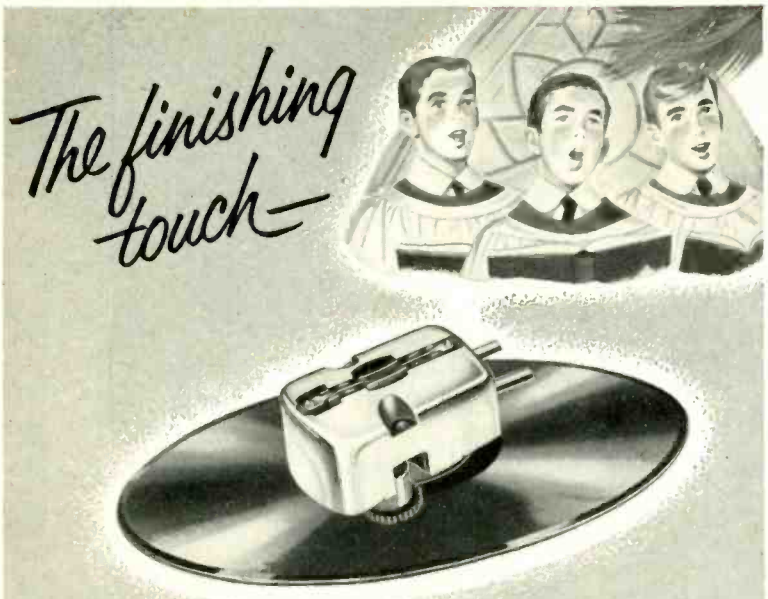
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heart,' any termination she could supply for their opera would be 'trivial.'"

In spite of its recherché libretto, the United States premiere of *Capriccio* (Angel 35084) last April at the Juilliard School was a warm success. This delightful musical dispute over poetry and music may be caviar for the general, but it also seems to have found its way down to the rank and file. In the Final Scene, released on the Angel label with Elisabeth Schwarzkopf singing the role of the Countess, we hear more than a mere echo of *Der Rosenkavalier*. The orchestration is luminous and gossamer-like in texture, the vocal line is, in keeping with the opera's subtitle, "conversational"—in short, the total effect is magical. Let's hope for a complete recording soon!

Apropos of the unity of words and music, no better examples can be found than in the *Four Last Songs*. Here Strauss returns to an early love, that of song composition. These four magnificent works represent Strauss at the height of his powers, both vocally and orchestrally.

The genesis of the *Concerto for Oboe* is an interesting one, as Paul Affelder tells it. "Early in the summer of 1945, a detachment of American soldiers was stationed near Strauss' home in Garmisch. Among the occupation forces were Staff Sergeant John de Lancie, now associate solo oboist of The Philadelphia Orchestra, and Alfred Mann, a musicologist from New York City. Knowing that the famous composer was living nearby, the two men obtained leave to pay him a visit one evening. During the course of their conversation, de Lancie commented on Strauss' frequent use of the oboe as a solo instrument in his tone poems and operas, and inquired why he had never written a concerto for the instrument. Had this question been put to any other octogenarian composer, he probably would have dismissed it with a shrug. But not Strauss. Within a matter of days, he was at work on an oboe concerto."

One critic pigeon-holed the work as neo-Mozartian because of its classical thematic treatment and its scoring, both of which are models of clarity. The flow of melodic ideas is organic and the entire work resolves around material presented in the first few minutes. Call it "conservative," "neo-classic," or what-have-you, the *Concerto for Oboe* (Col ML 4775) is a thoroughly delightful work whose lyrical qualities are projected within the framework of inspired craftsmanship.

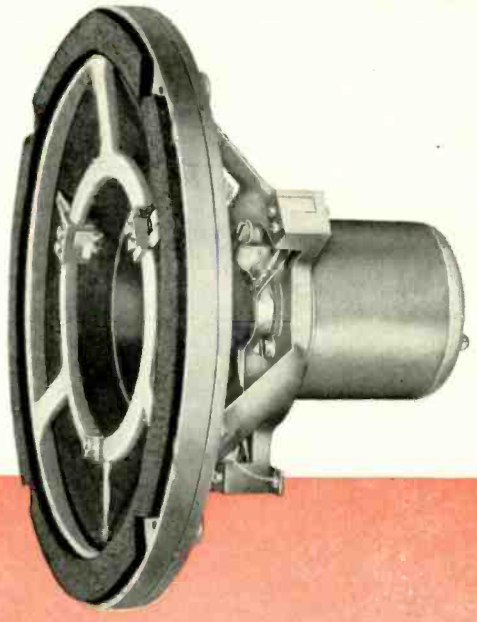
On a different level of intensity is *Metamorphosen* (Angel 35101) which Strauss composed in a month's time early in 1945. The last page of the score contains the words: *In Memoriam*. Because Strauss did not specify for whom the work was written, coming as it did then, it was assumed to be an elegy on the Third Reich. Three years ago, however, it was discovered that Strauss had written the score as a lament for the Munich Opera House which had been demolished in an air raid. *Metamorphosen*, was described as a "genius' farewell to his age and a salute to the great men of the past. A melancholy salute of which the tender grief for a vanishing world, for the ending of a radiant cultural epoch, a golden age, cannot but touch us to the very heart."

(*Continued on page 65*)

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EDITOR'S REPORT

END OF THE SHOW SEASON

WITH THE FIRST of November comes colder weather and the possibility of snow—and with it a respite from the rigors of the fall audio-show season. The advantage of the colder weather is that we are more likely to stay at home and put into effect some of the ideas we dreamed of during the summer months, when we are likely to be long on ideas and short on ambition. Between now and February we may get an opportunity to fit ideas gleaned from the past few shows into our home systems—just in time to start thinking about remodeling with the February-acquired ideas.

But we must look back over the past two months to see what has happened in the audio field—to think over the new equipment we have seen and to try and draw a few useful conclusions about where audio is going. To anyone who attended any—or perhaps all—of the fall shows, commencing with the International Sight and Sound Exposition in Chicago around the first of October, and continuing with the Audio Fair in New York and most recently with the eye-opening New England High Fidelity Music Show in Boston—it should be apparent that the public interest in hi-fi is still growing. Which is exactly what we have been saying for years.

Three days of rather warm weather in Chicago drew a crowd said to be around 28,000. And it was a buying crowd, we are told by one exhibitor who said that after the people visited the exhibits at the Palmer House on Thursday they apparently went down to the exhibitor's store on Friday and Saturday and bought the things they saw. That's what the shows are for, of course, but it is most encouraging to be able to assess the results so quickly and so definitely.

The sixth Audio Fair at Hotel New Yorker topped the previous record, with an attendance of something over 30,000. This year's innovation—that of holding the show on a Sunday—appears to be an excellent idea, for the halls were crowded all afternoon. There are undoubtedly many who are not conveniently able to attend on the week days, so the Sunday holdover makes sense in more ways than one. Another advantage of this year's Fair was that the exhibits were open every evening, since the Audio Engineering Society banquet was held the night before the opening of the Fair. Attendance was excellent every evening, and undoubtedly the visitors would have stayed until 11:00 or 12:00 if the exhibits had remained open that long. But regardless of visitors' enthusiasm, those who are on their feet throughout the nine-hour days get well worn out by closing time, and they are glad to coax the last lingering visitor out the door and bolt it before any more filter in. The New York show is becoming better behaved each year—whether because the impact of louder sound, more highs, and more bass caused more aural pain than it caused buying or whether those who are responsible for the average sound level have become real music lovers themselves and consequently prefer more normal listening levels, would be hard to say. However, we are glad to observe that in most exhibits the quality of sound is improving yearly, even though the quantity may be decreasing.

The surprise of the season proved to be the Boston show, for here—in a city where no such event has been held before—over 15,000 turned out for the three-day exhibit. Bostonians are fortunate in having five "good music stations" on the air, and perhaps they are more accustomed to music than in the other cities. Suffice to say, however, that the crowd was exceptionally well mannered—at the appointed closing hour, most of the exhibits were already emptied of people, for example, and no force was required to get the doors shut. The Hotel Touraine is not large, but the corridors are wide and progress from room to room is relatively unimpeded. Our hat is off to those who made the first show in Boston so successful, and we trust that future shows will continue to be so well attended and so well appreciated.

While we did not attend the Second Annual High Fidelity Audio Show in San Francisco on September 11, 12, and 13, we are told that some 16,000 other people did. This exhibit was put on by the local hi-fi shops, parts jobbers, factory representatives, and record companies, and was not, in general, staffed by factory personnel. However, the success of the San Francisco show indicates that such an exhibit can be put on successfully by the "local talent," and we wish them continued success.

And now, a rest—except for the Christmas and New Year celebrations—until February and the Audio Fair—Los Angeles.

AUDIO PRACTICES COURSE

We are in receipt of a circular from University Extension, University of California, Los Angeles, telling of a new course which commenced on September 21 at Royce Hall on the UCLA campus at Westwood. The title of the course is "Audio Practices for Engineers and Musicians," and is described as being a treatment of music, emphasizing its technical basis, terminology, acoustics, orchestral instruments, sound reproducing systems, and a discussion of binaural and stereophonic sound.

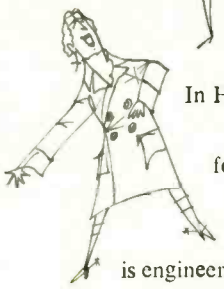
While this is hardly a course in audio engineering, of which we know of none anywhere in this country at the university level, it is certainly a step in the right direction. The training of audio engineers for professional work requires a different approach than the presentation of audio as it is related to music—or *vice versa*. Both are vitally necessary if we are to have improvement in recording and broadcasting techniques and if we are to have intelligently installed hi-fi systems with the proper choice of equipment for the specific uses to which it will be put.

The University Extension course gives a credit of three units, meets every Tuesday from 7:00 to 9:30 p.m., and is being given by Laurence Petran, Professor of Music and University Organist at UCLA, and Walter Goldsmith, Sales Engineer, Minthorne Music Co., Inc.

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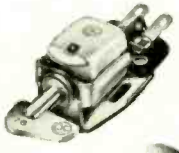
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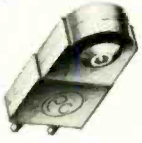
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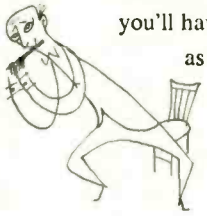


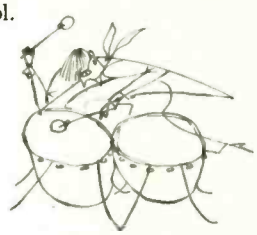




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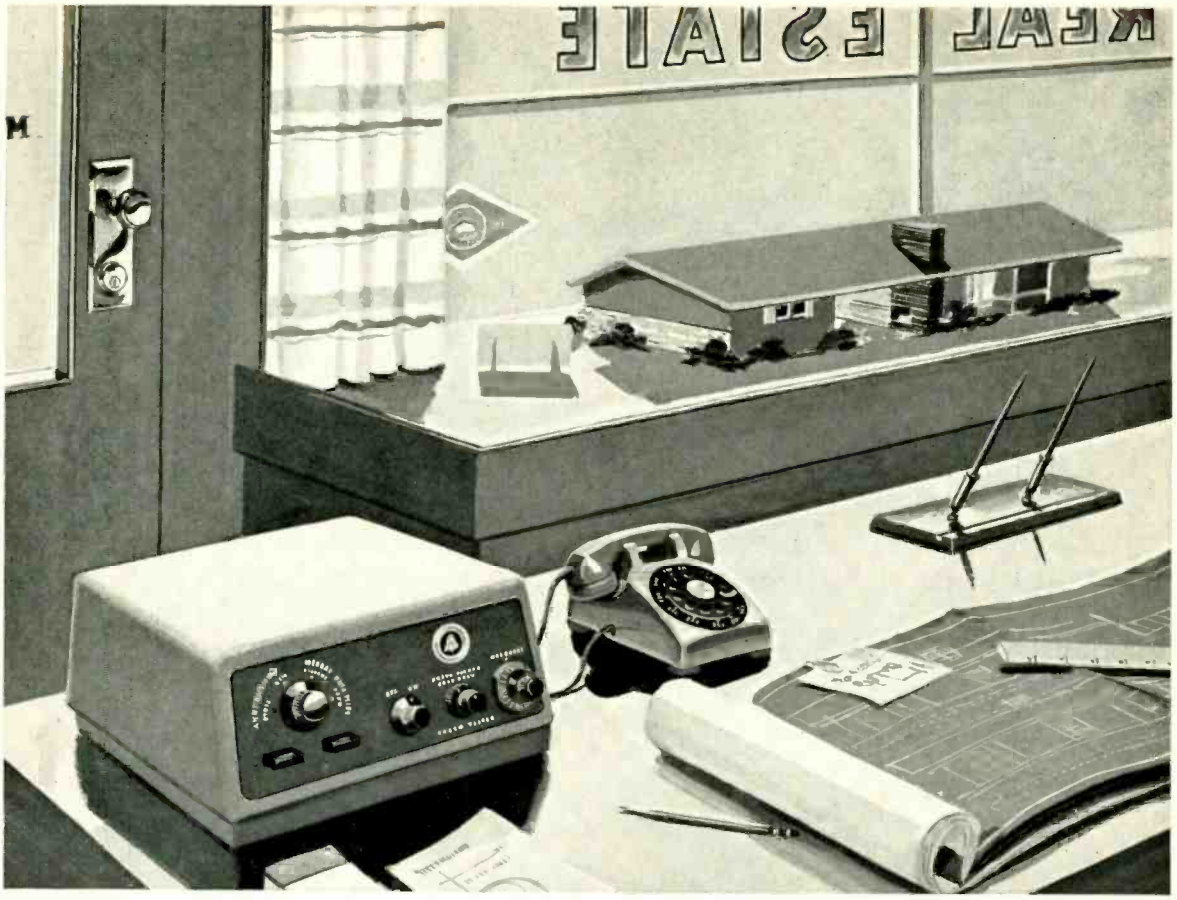
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New Amplifier has Bridge-Circuit Output

D. J. TOMCIK AND A. M. WIGGINS*

A new output circuit for a high quality audio amplifier is described. It is one which eliminates switching transients, provides unity coupling of the two output tubes and has low quiescent current. A comparison is made between this and conventional push-pull circuits.

HIGH-QUALITY AUDIO AMPLIFIERS have always been the strongest link in the chain of components required in a reproducing system. Even though a high degree of excellence has been attained in most existing amplifiers, much is left to be accomplished in their application to the system. The power stage and the output transformer are the portions in which one can expect the greatest advances in materials, techniques, and circuitry.

Output Transformer Requirements

One requirement for a high-quality output transformer in a conventional push-pull circuit is that it must have negligible leakage reactance to avoid transient distortion due to collapsing currents when each tube is driven beyond cutoff. The collapsing current which causes the transient condition appears as a parasitic oscillation in the wave-form at the plate current cutoff points. A large value of leakage reactance also causes the transformer efficiency to decrease at high frequencies, resulting in a reduction in power-output capability, as well as increased distortion and poor frequency response.

Another requirement of an output transformer is that the distributed capacitance of the winding be low to insure power-handling ability of the amplifier at high frequencies. Excessive distributed capacitance also causes attenuation of the high frequencies and excessive phase shift.

Still another requirement is that the transformer have enough inductance to reproduce the lowest frequency desired.

This article describes an output circuit which relieves the output transformer of many of these limiting effects and which overcomes many of the inherent disadvantages of the conventional push-pull circuit.

Description of Circuit

Figure 1 shows a push-pull output circuit which has departed radically from the conventional circuitry. In order to show the circuit in a simplified form in the schematic, batteries are used in lieu of power supplies. One of the two power supplies necessary with this circuit is connected from the plate of each tube to the cathode of the other. The d.c. plate current of each tube circulates through both power supplies *without passing through the windings of the output transformer*. Only a negligible current caused by the dissimilarity in the output tubes flows through the output transformer.

The circuit is drawn to illustrate that it is a balanced bridge under no-signal conditions. The bridge consists of the

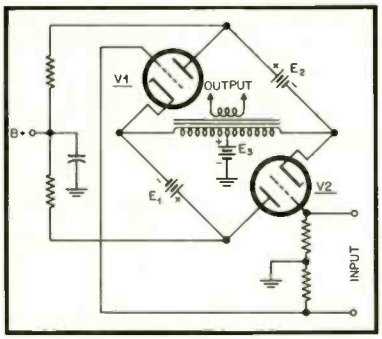


Fig. 1. Circuit diagram of output circuit showing B-supply for low-level stages.

two tubes V_1 and V_2 and the two power supplies E_1 and E_2. The output transformer is placed across the bridge from cathode to cathode and is provided with a centertap which establishes the grid-to-cathode circuits through the bias E_3. Identical operation can be had by placing an untapped transformer from plate to plate and by providing grid-to-cathode continuity with high resistances from each cathode to bias voltage E_3. In the interest of simplicity, the tubes are shown here as triodes although pentodes, tetrodes, and beam-power tubes can be used as well.

The total primary winding is presented as a load to each tube. One half of this load is in the cathode circuit and the other half is in the plate circuit. The plate load of one tube is the cathode load of the other (and *vice versa*). Since each tube looks into the same load, there is perfect load coupling between the tubes. Though considerable leakage reactance may exist in the transformer, no switching transients can occur when either of the tubes is driven past cutoff, since both halves of the primary have the same signal current flowing through them. Thus switching transients, which are so troublesome in conventional push-pull class AB and B amplifiers, and which place severe requirements on the output transformer, are eliminated with this arrangement.

The impedance of the primary winding of the transformer in this circuit is only one-fourth the impedance of the plate-to-plate winding used in a conventional push-pull output circuit using the same type of tubes. This lower impedance primary permits the transformer to be wound with much less capacitance than would be possible with the higher impedance of a conventional circuit.

Any amount of cathode feedback can be obtained by using transformer interstage coupling and connecting the cathode lead of an interstage transformer secondary to appropriate taps on the output transformer winding. For example, in designing the amplifier it is possible to use class AB_1 operation with R-C coupling and maximum cathode degenerative feedback, as is the case in *Fig.* 1. Under these conditions the new output circuit is similar in operation to a cathode-follower type, and has a voltage gain of less than one. The cathode follower has the advantage of a large amount of feedback, with resultant low distortion along with low output impedance.

The perfect coupling between the two tubes allows the tubes to be operated with low quiescent current—almost to the point of class B operation. Operation under these conditions allows the circuit to produce more power without exceeding the rating of the tubes.

The Drive Circuit

Since the output stage gain is less than unity in a cathode-follower circuit, a higher drive voltage is needed on the grids than in a circuit with less feedback. This higher undistorted voltage can be obtained without increasing the plate voltage of the drivers with the circuit

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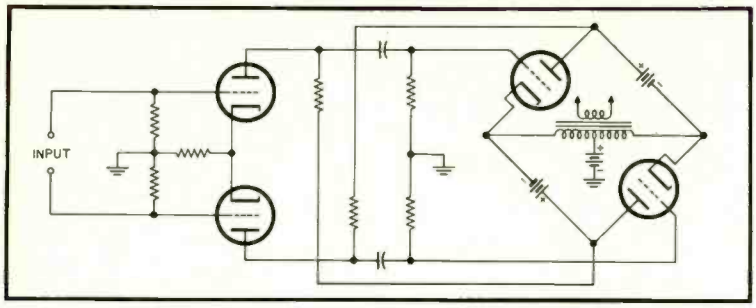


Fig. 2. Circuit diagram of output stage and driver stage.

shown in *Fig. 2*. In this circuit the B+ of the driver tubes is taken from the plates of the output tubes. This increase in B-supply due to the addition of one-half of the output signal voltage to the supply permits the driver tubes to operate linearly over a greater range of grid voltage than would be possible with the same fixed supply voltage.

B-Supply for Low-Level Stages

In the circuit diagram of *Fig. 1* two power supplies are shown, both of which are above ground. The total output signal appears between the two power supplies while one-half the signal appears

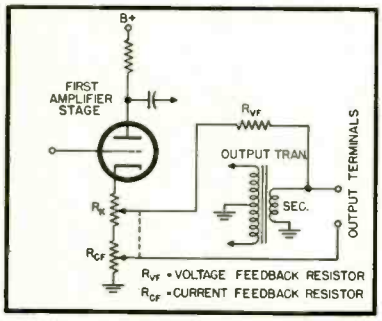


Fig. 3. Circuit diagram showing variable voltage and current feedback used to change internal impedance of the amplifier.

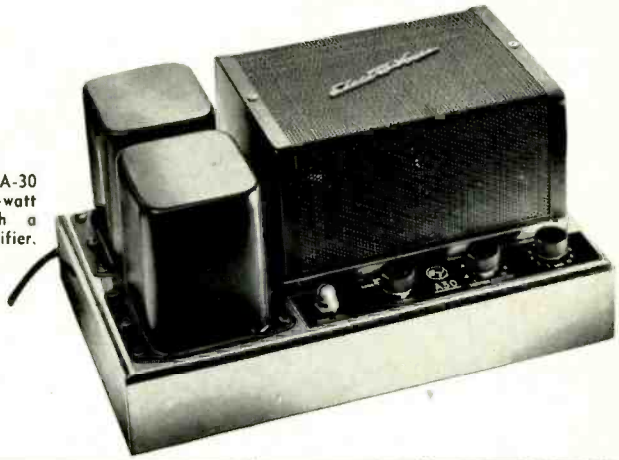


Fig. 4. The A-30 amplifier, a 30-watt unit used with a remote preamplifier.

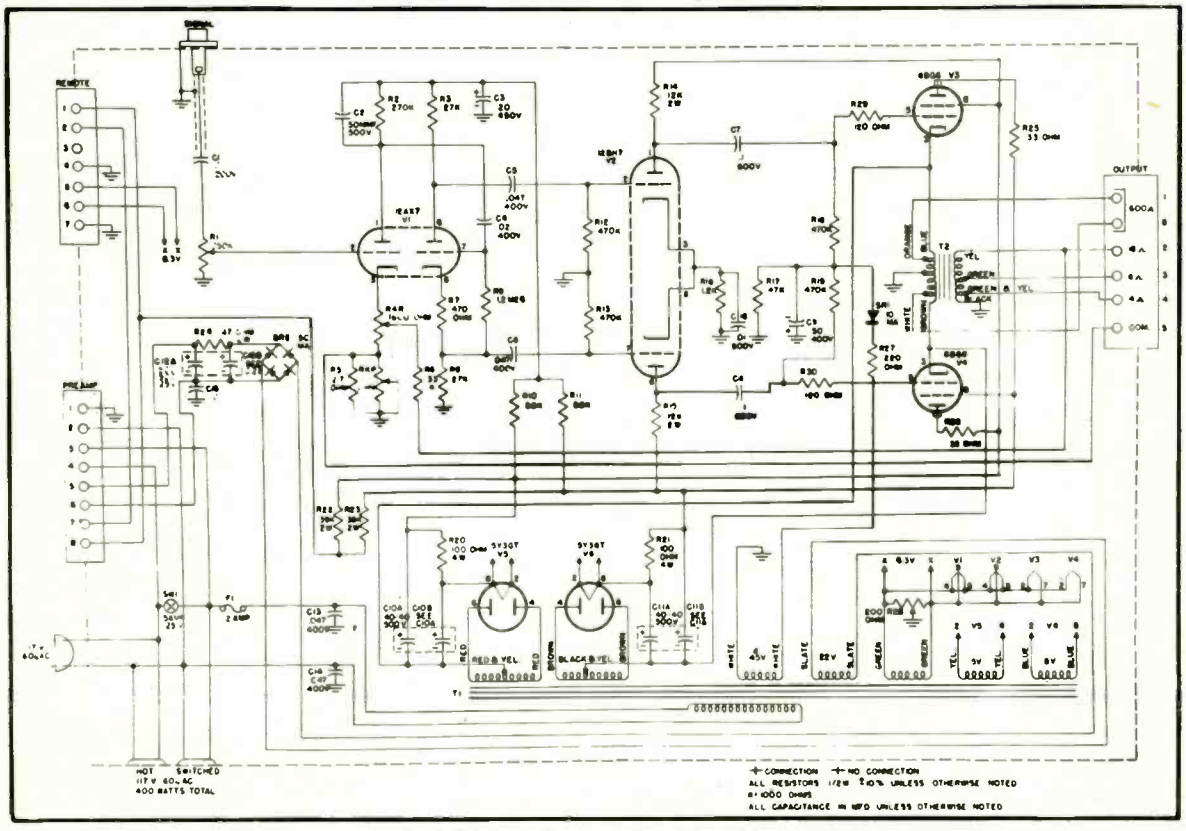


Fig. 5. Schematic diagram of the A-30 amplifier.

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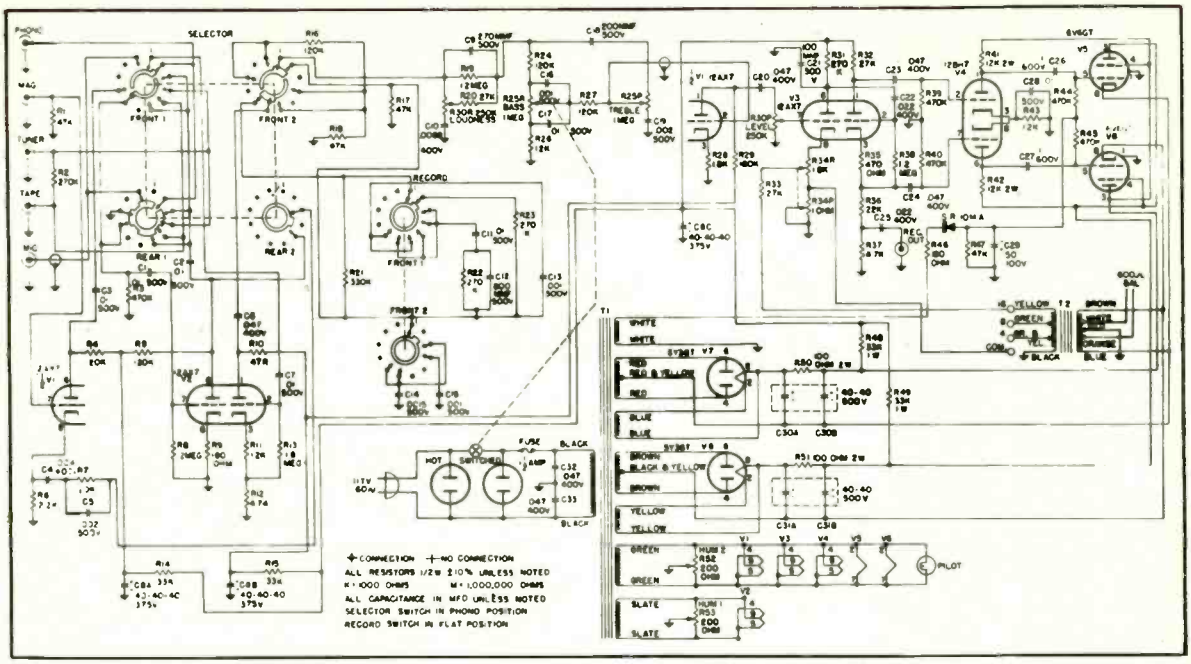


Fig. 7. Over-all schematic of the A-20-C amplifier-preamplifier.

between each power supply and ground. The lower-level amplifier stages and phase splitter must be provided with a single power supply with the negative terminal grounded. *Figure* 1 shows how this is accomplished. Two equal resistors are connected to the two B+ voltages. At the junction of the two resistors a capacitor is connected to ground. No signal voltage exists from the junction of these two resistors to ground since the circuit is balanced. Any small out-of-balance signal is filtered by the capacitor. This provides a B+ for the lower level stages which is free from the signal in the output stage.

Variable Damping Factor

It is desirable to have the amplifier present the correct impedance to the speaker to achieve optimum speaker performance at low frequencies. This value of speaker critical damping resistance varies widely with different speakers and is dependent on such parameters as the flux density, type of enclosure, length of conductor in the air gap, etc. In the finished model of the amplifier, means are provided which allow the internal resistance of the amplifier to be varied over a wide range. This variable internal resistance allows the amplifier to be adjusted so that it presents the optimum damping factor for critically damping any speaker combination. Damping factors greater than unity are achieved by varying amounts of negative *voltage* feedback from the output to the first stage cathode circuit as shown in *Fig.* 3. Conversely, damping factors less than unity are produced by varying amounts of negative *current* feedback obtained from the low resistance inserted in the speaker circuit. By combining the two types of feedback with the aid of a ganged potentiometer as shown, the overall feedback is maintained constant. The damping factor, however, is varied over a wide range. Needless to say, the maximum power available from the amplifier is independent of the damping factor and remains constant.

Performance

Several designs of amplifiers were developed using the basic theory explained in the preceeding paragraphs. These are currently available in the Electro-Voice, Inc. line of high-fidelity amplifiers. One of the units, the A-30, is shown in *Fig.* 4. The circuit diagram of this amplifier is shown in *Fig.* 5. It is a line amplifier designed to be used in conjunction with a remote preamplifier unit. Another unit, the A-20-C has a complete preamplifier section integral with the power amplifier, and is shown in *Fig.* 6. The operating specifications of the two units are shown in Table 1.

Figure 7 is the schematic of the smaller unit, showing the input circuitry, tone controls, and phono equalization circuits. Provision is made for both magnetic and ceramic or crystal pickups, and a high-gain "flat" input is provided for microphone input.

TABLE 1

AMPLIFIER PERFORMANCE

	A-30	A-20-C
Output Tubes	2-6BG6	2-6V6GT
Rated Output	30 Watts	20 Watts
Frequency Response	0.25 db	1 db
Harmonic Distortion at Rated Output	20-50,000 cps	20-20,000 cps
Intermodulation	Less than 1%	Less than 1%
Distortion at Rated Output	Less than 1%	Less than 1.5%
Hum and Noise	-90 db	-70 db
Total Feedback	31 db	33 db
Damping Factor	Between 0.1 and 15	Between 0.1 and 15

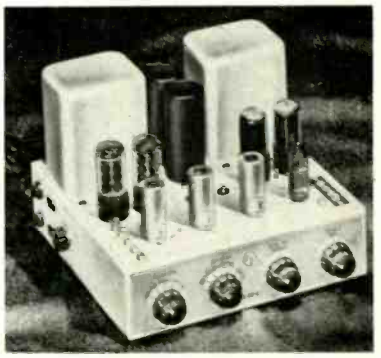


Fig. 6. The 20-watt model, A-20-C, with a complete built-in preamplifier.

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Resonance Effects With R-C Circuits

GLEN SOUTHWORTH*

Resonant filters and equalizers are sometimes useful in audio systems. They can be made cheaply with a single tube and resistance-capacitance components, with the added advantage that both Q and frequency are easily variable.

IN MANY AUDIO SYSTEMS there arises a need to provide corrective frequency equalization of a nature different from that provided by conventional boost or cut tone controls. Frequently steep slopes are desirable to compensate for electromechanical deficiencies, poor signal sources, or the Fletcher-Munson characteristic when listening at low levels. Similarly, it is usually desirable with many signal sources to attenuate either bass or treble boost rapidly after a fixed frequency in order to minimize the disagreeable effects of extraneous low- or high-frequency noise.

Resonant equalization possesses a number of distinct advantages over conventional R-C circuits. These include rapid attenuation after a specified frequency has been reached, the ability to achieve sharply rising or descending frequency characteristics, and certain transient characteristics. It appears to be the last named factor which has led to some prejudice against the resonant equalizer.

The ultimate desirability of resonant elements in audio circuitry seems to be very strongly influenced by the quality of the associated equipment as well as the tastes of the individual listener. In the case of a poor system the introduction of a resonant element at midfrequencies, with a Q as low as 1, may produce disagreeable tonal coloration, but in a system of excellent initial performance the introduction of resonant Q's up to 20 seem to have little detrimental effect.

There are several constructional problems that may occur in conventional L-C resonant equalizers. These include the necessity for good, high-Q inductances,

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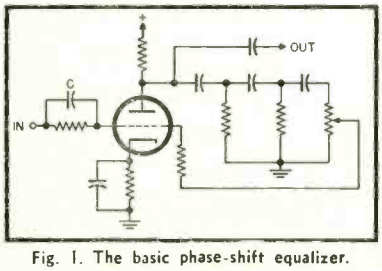


Fig. 1. The basic phase-shift equalizer.

the requirement of low hum pickup from a.c. magnetic fields, and lack of continuously variable tuning at low frequencies unless special variable inductors are used. In addition, L-C circuits are usually of fairly low impedance, have considerable insertion loss, and may increase the distortion of the system somewhat.

The Phase-Shift Circuit

To avoid most of these problems, a special resistance-capacitance configuration may be used in a feedback loop to stimulate the effects produced by L-C components. The basic circuit, bearing considerable resemblance to the phase-shift oscillator, is shown in *Fig.* 1. The tube acts as a phase inverter, and as an amplifier to overcome the losses produced by the R-C phase-shifting network. The R-C system provides approximately 180 deg. of phase rotation at "resonance" and the output of the network is fed back to the grid of the tube through a potentiometer which is used as a means of varying the effective Q of the circuit. As the resonant frequency is determined by the values of the R-C elements, it is obvious that the resonant point may be located in any part of the audio range, or may be made continuously variable over part of the spectrum.

The use of simulated resonant circuits has a number of advantages which include the use of high-impedance circuitry, low cost, flexibility, and relative freedom from magnetic hum pickup. In addition they introduce relatively little insertion loss, gain being slightly less than unity for off-resonant frequencies at the point of maximum feedback or highest Q, while for lower values of apparent Q the circuit will actually contribute gain at all frequencies. The ultimate performance of the simulated resonant circuit is influenced not only by the choice of operating frequency and apparent Q, but by any linearity distortions that may be introduced. If the circuit or audio system tends to discriminate against weak signals, the output of the resonant element will not blend well with signal components in other frequency ranges. This means that the choice of tubes employed in the simulated resonant circuits is of importance, as well as the selection of the resistive and capacitive elements in the feedback loop. In the circuit shown in *Fig.* 1, tube distortion is largely compensated for at frequencies considerably above resonance due to the fact that an appreciable amount of inverse feedback is applied at these frequencies when the Q control is advanced. However, tube distortion may cause sound in the region around resonance to be lacking in "liveness." In the case of the R-C elements it should be noted that some voltage coefficient may exist in composition type resistors, while capacitors may exhibit a form of dielectric hysteresis. It is interesting to note that when these elements are placed in a feedback loop the type of linearity distortion produced is opposite in character to that occurring in a normal voltage amplifier, and it may produce a slight amount of compensation for distortions of this nature occurring elsewhere in the audio system.

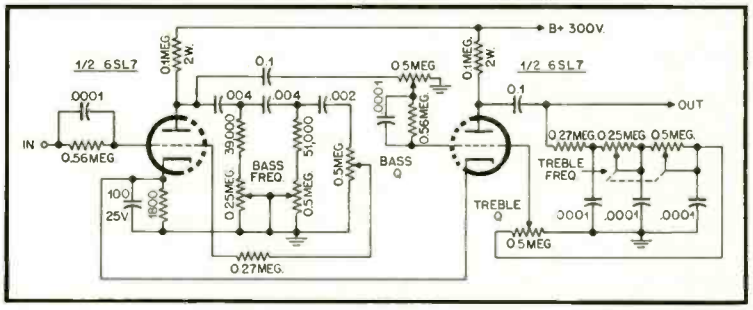


Fig. 2. Complete equalizer for bass and treble with two variable resonances and variable Q's.

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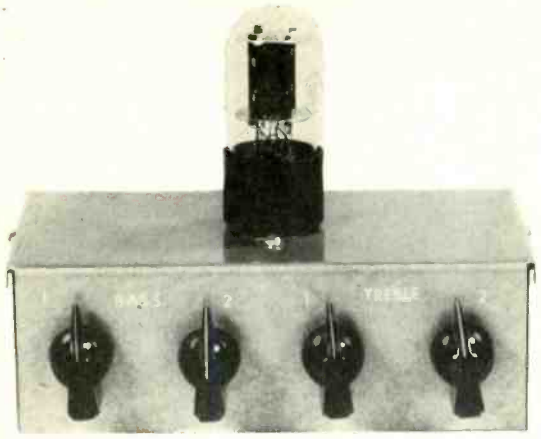


Fig. 3. A working model of the circuit of Fig. 2.

A Complete Equalizer

Figure 2 illustrates a practical circuit for both bass and treble equalization. Q controls are employed with both high- and low-frequency resonances and two of the resistive elements in each of the phase-shifting loops are made variable in order to make the resonances tunable over an appreciable band of frequencies. With the values shown, the low-frequency element is tunable over a range of 50 to 150 cps, while the high-frequency resonance is variably peaked between 4,000 and 10,000 cps. In the case of the high-frequency section, the values of capacitance required in the phase-shift loop are relatively small in value and a two-section, variable capacitor may be substituted as the frequency-determining control in place of the variable resistors. *Figure* 3 shows a finished equalizer.

Although preferred by the author, the circuitry of *Figs.* 1 and 2 have the disadvantage of being, for the most part, loss-type equalizers—the over-all volume level drops when bass or treble boost is employed, although the actual gain at the resonance point may be appreciably higher than normal due to the fact that the feedback at this frequency is essentially positive. Both circuits are designed for low-level operation and care must be taken to limit input signals to about 1 volt.

Another type of operation is shown in *Fig.* 4, which is suitable for medium or reasonably high-level operation. In this case the plate circuit of the simulated resonant circuit is placed in parallel with a high-impedance load carrying the audio signal. This has the advantage of making possible a simple 2-wire connection to existing equipment.

Several types of these simulated resonant elements have been constructed by the author and used in conjunction with a wide variety of audio equipment by people of varying tastes and in different acoustic environments. Although in nearly all cases the circuits have been non-tunable, the reaction approximately 70 per cent of the time has been definitely favorable, while others have tended to regard the device as an interesting, but not essential, novelty. *Figure* 5 shows the frequency curves obtainable with the equalizer of *Fig.* 2.

Of special interest to the listener who must hear his records at low volume levels is the special type of compensation for the Fletcher-Munson characteristic that the high-Q circuit element affords. Although excessive ringing of the resonant elements may be quite irritating at high sound levels, the added duration

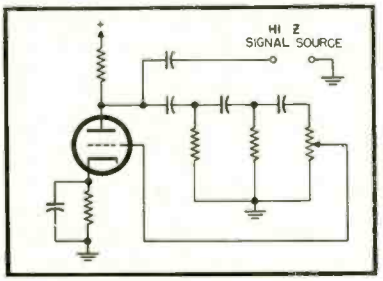


Fig. 4. Where higher signal voltages are involved, the plate circuit of the triode can be connected across a high-impedance audio circuit.

given to musical transients frequently appears to be desirable at low listening levels and can lead to a pleasant, warm bass register and clear high frequencies at sound intensities well below the conversational level.

The use of low-Q resonant elements in the high-frequency region seems to make the crystal phono pickup sound more like its magnetic counterpart. Both high- and low-frequency resonances can render audible previously unnoticed transients (either noise or musical) and it is desirable to have a turntable with little rumble if high-level reproduction is contemplated. Likewise, various elements of a radio station's technical personality seem to come to life as evidenced by an assortment of noises which are interesting and meaningful to the listener engaged in the broadcasting field. The old expression, "I heard things I've never noticed before," seems definitely to apply to the use of resonant elements, and in many cases this appears to be an expression of genuine appreciation.

Electronic Music Use

It appears that a great many people who have been interested in high-quality sound are extending their interest to electronic musical instruments such as organs. The simulated resonant circuit described here has been used with excellent success in at least one electronic organ to take the place of inductors in formant circuits, and amateur organ builders may well wish to use them for this purpose.

The tone-coloring circuits of the Minshall organ, described in detail in a new book, "Electronic Musical Instruments," by Richard H. Dorf,[1] employ these filters to simulate the body resonances of acoustical instruments. They are used for such stops as horn, string, diapason, and cello, each of which is given a resonance at a different frequency and further modified by additional circuitry of a low-pass or high-pass nature. Curves showing the spectral characteristics of the stop channels appear in the book.

The form of the circuit used by Minshall is essentialy the same as that shown in *Fig.* 4, except that the grid of the tube, rather than the plate, is shunted between the signal line and ground. The tube is a 12AX7 and a total of four of the triodes are used in as many resonators. While Minshall has juxtaposed some of the resistors and capacitors in the phase-shift network, experimenters may find the *Fig.* 4 arrangement good.

[1] Published by Radio Magazines, Inc., P. O. Box 629, Mineola, N. Y., at $7.50.

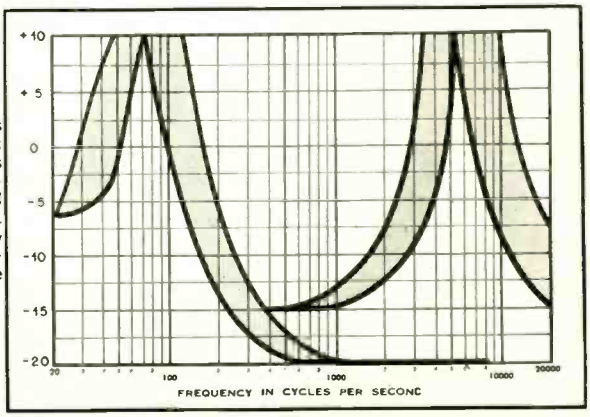


Fig. 5. Response curves obtainable with circuit of Fig. 2. Solid curves show results with controls set for 90 and 5,500 cps and Q of about 10. Shaded regions show limits of possible equalization with values of the diagram.

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Phones for Fidelity

PETER W. TAPPAN*

A discussion of the advantages of headphones over loudspeakers for high-fidelity listening, presenting some factors not often considered, and including a brief description of available hi-fi phones and how to select and connect them.

THE HEADPHONE SET as a means of high-fidelity home music listening is too often overlooked. Since the demise of the crystal radio era, phones have become associated primarily with short wave receivers and dictation machines. In both of these applications it is desirable that the phones' response be limited to a rather narrow frequency range to reduce hum and noise and so increase intelligibility. Consequently the earphone, to many, has become synonymous with low-fidelity reproduction and is not even considered as a possible transducer for good quality music. To a suggestion that he try phones, an avid but uninformed hi-fi lover might protest, "What! When I've got a $200 speaker system? What do you think I am, a ham or something?"

The writer will readily admit that the loudspeaker possesses a number of advantages not shared by phones, and that a good speaker system is a desirable asset. The biggest advantage of the speaker is, of course, that nothing need be worn on the ears and the listener is free to move about, unhampered by a cord tethering him to his installation. In addition, when several want to listen, one instrument suffices for all. If music is to be used merely as a background at a social gathering, it would be ridiculous to provide each person with phones. Not only would they be inconvenient to wear, but they would also necessitate louder conversation since they attenuate external sounds somewhat. Another factor is that it is possible to obtain a speaker system with frequency response considerably better than the highest-fidelity earphones. It should be remembered, however, that frequency response is but one of a number of parameters influencing fidelity.

For many applications, then, speakers are superior to phones and in some instances are the only satisfactory solution. But how about the serious listener who wants to relax and hear his favorite music with the best possible fidelity and without outside distractions? Here are the reasons why he might well consider adding earphones to his present loudspeaker system.

Privacy of Phones

First and most obvious, the headset owner can listen without disturbing anyone. Not only can he listen, but he can hear the music at any volume level he desires. He can enjoy *Marche Slave* or *Stars and Stripes Forever* at full concert-hall volume at midnight without waking the baby, annoying the people downstairs, or being evicted by the landlord. Conversely, the phones also serve to attenuate external sounds so that they become less bothersome to the listener. Thus he can reduce the intrusion upon his music of the cacophony of the fellow playing "Chopsticks" on the piano upstairs, the clattering of pans and dishes in the kitchen, and the rumble of passing vehicles.

Absence of Room Acoustics

Perhaps the most important and certainly the most overlooked advantage of phones is the fact that they circumvent the distortions associated with room acoustics and speaker directional characteristics. Some people will buy correctly an expensive loudspeaker claimed to be flat ± 5 db from 40 to 13,000 cps when in the proper enclosure, but will assume incorrectly that they are hearing a response this flat when the speaker and enclosure are installed in their living room. What they are forgetting is that the speaker response was measured in an anechoic chamber or in an open field and, in all probability, on the speaker axis unless otherwise stated. In the living room, reflecting surfaces such as walls and furniture alter the response considerably. Standing waves are set up, introducing peaks and dips in the response no matter what the listening point. Anyone who doubts that such an effect occurs need only listen to a steady tone of a few thousand cycles, while standing at some distance from the speaker and moving his head slowly in various directions. He will be amazed at the loudness variation attendant to a movement of only a few inches in some directions. In addition, the room will have resonances at certain frequencies, as well as its own reverberation that will add to that of the program source.

The reader may argue that these effects occur in the concert hall, and indeed they do, but in such a large enclosure they are considerably different than in the living room. Obviously, when earphones are used none of these effects can alter the reproduced sound. There can be no room resonances, standing waves or unwanted reverberation. Room characteristics simply do not enter the picture.



Fig. 1. Brush model A-1 headset.

The Sound Image

One disadvantage common to both phones and the usual speaker system is that they are highly localized sound sources. Consider a symphonic program being played through a 15-in. speaker in an infinite baffle. Every reproduced sound from every instrument in the orchestra is coming from a single diaphragm about 13 in. in diameter. The effect will be the same as if the speaker cone were replaced by a hole of the same diameter, through which the sound is allowed to enter the room. Combined with the room characteristics previously described, this sound localization produces a listening sensation similar to what one would expect if he were to place his living room in the middle of a concert hall and permit the sound to enter through a slightly opened window—an unusual situation to say the least. Headphones, too, are imperfect in this respect. The sound at one ear is always identical in phase and amplitude to that at the other ear, which is the condition that occurs when an "in the flesh" sound source is anywhere in a plane that perpendicularly bisects a line between the ears, or in other words, in a vertical plane that slices the listener down the middle. Further, when the headphone listener rotates his head slightly in any direction, the sound does not change. There is only one place in this vertical plane where a natural sound source may be located and satisfy the condition that rotation of the head will not change the sound, and that is within the head itself. Thus the phones listener identifies the sound as coming to him from a point in the middle of his head, absurd though it may seem. Actually, it might be better to say that it appears to come to him *through* a point in his head, because

* *142 South Oak St., Bartlett, Ill.*

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unless the music was played in a completely "dead" room, reverberation will reveal that the program originated in a fair-sized enclosure. Again, a highly unusual situation.

It is evident, then, that neither the usual speaker system nor headphones can reproduce a single-channel symphonic program realistically with respect to sound source location and size. The writer has found, however, that while listening with phones an unconscious mental adjustment occurs, if allowed to, that projects the consciousness into the original concert hall, much as one projects his consciousness or awareness into a story he is reading or a movie he is watching. A similar effect undoubtedly occurs with a loudspeaker, but here one has to ignore not only the apparent sound source but also the room acoustics.

It should be emphasized that the preceding discussion applies only to symphonic or other programs where the total sound source is of considerable size or is played in a reverberant enclosure of appreciable size. Where the source is small, and is played in a reasonably dead room, the loudspeaker definitely has the advantage over headphones when fidelity of reproduction is the only consideration. This is especially true if the source is about the same size and shape as the speaker system, as in the reproduction of a cello solo. Here both the size and location of the source may be reproduced accurately by a speaker but not by phones. Further, since a cello or other instrumental solo is frequently played in a room of the same general size and acoustical characteristics as a living room, the loudspeaker reproduction will be enhanced rather than worsened by reverberation in the listening room, provided that the original playing room was fairly dead.

Stereophonic and Binaural

While on the subject of sound source location and size, it might be well to point out that with increasing popularity and availability of stereophonic recordings, broadcasts, and tape recorders, many technically inclined music lovers will be adding stereophonic reproduction equipment to their present systems. In most instances this equipment will be limited to two channels, and a two-channel system sounds much better with phones than with speakers. It is not difficult to understand why this should be true. Both binaural and two-channel stereophonic programs are usually picked up with two microphones. Suppose they are spaced ten feet apart, a typical figure for stereophonic pickup, and suppose that when the program is reproduced the speakers are a like distance apart and the listener is equidistant from both speakers. Then a sound source located very close to the left microphone will be reproduced so much louder by the left speaker than by the right that sound from the latter will be masked out or at least seem like a faint echo, and the listener identifies the left speaker as the source. Sound from a source equidistant from both microphones will reach the mikes at the same time and be

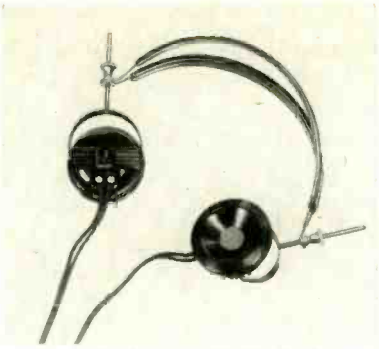


Fig. 2. Brush model BA-206 headset.

reproduced in phase and with equal loudness by the speakers, reaching the listener as a combined wavefront that appears to come from a point midway between the speakers. So far, all is well. A wavefront from a source not in the immediate vicinity of the left mike, but appreciably closer to it than to the right mike, however, will be picked up and reproduced by the left channel sooner than by the right, and will reach the listener as two separate wavefronts at different times and from separate sources—hardly a realistic reproduction. Well then, one might ask, why not move the mikes close together, about the same distance apart as the ears, so that the time interval between the arrivals of a wave front at the two microphones can never exceed that which would be experienced by the ears in the same position. In effect the concertgoer's ears would be replaced by microphones. An excellent suggestion. This is just what is done when the reproduction is to be binaural —that is, with earphones. Using phones, the right ear hears what went into the right mike, and the left ear hears what went into the left mike, and the effect is just as though the listener were at the concert himself, with the exception that turning his head produces no effect on the sound. But if we replace the phones with speakers, regardless of their placement each ear can hear both speakers and the isolation between the channels is destroyed. It is much the same as when one removes his polaroid glasses at a three-dimensional movie, and each eye sees not only its proper image but also the image meant for the other eye. Thus, it is clear that two-channel stereophonic reproduction is inferior to binaural reproduction. In the experience of the writer and both technical and nontechnical friends, even a program that is picked up stereophonically, with the microphones a number of feet apart, sounds more realistic with headphones than with speakers. Consider a wavefront that arrives at the left mike one millisecond sooner than at the right mike, a typical situation if the mikes are several feet apart. Then the left speaker will reproduce it one millisecond before the right speaker does. The left wavefront proceeds to the listener and reaches his left ear first. Perhaps a quarter millisecond later it reaches his right ear. Then, the right wavefront reaches the right ear after another ¾ millisecond, and gets to the left ear a quarter millisecond later. The listener actually hears the wavefront four times! With phones he obviously only hears it twice, once at each ear, the normal number of times even though the one-millisecond interval is still abnormal. Thus while he cannot always pinpoint each instrument in the orchestra, he nevertheless experiences a much greater feeling of "presence" than when listening with speakers.

High-Fidelity Phones

The reader is cautioned that the ordinary bipolar or magnetic-diaphragm headset is a far cry from high fidelity. The old reliable "cans" may be fine for communicating with W2ICU or pulling in Australia, but their uneven, limited frequency response and tendency to overload at moderate loudness levels render them unsuitable for the critical musical ear. For good quality music reproduction it is necessary to use phones that have been designed with fidelity in mind.

At least three companies are prominent in the hi-fi headset field. The Brush Electronics Company's models A-1 and BA-206 (*Figs.* 1 and 2) are high-impedance crystal headsets costing about $10.50 and $16.50 respectively. According to the manufacturer, the second model has a somewhat smoother response. The specified impedance of the A-1 is approximately 160,000 ohms at 1000 cps and tapers to 80,000 ohms at 10,000 cps. That of the BA-206 is about is about 80,000 ohms at 1000 cps, and 12,000 ohms at 10,000. These high impedances make the units attractive since they readily permit operation without an output transformer. The Permoflux Corporation's models DHS-17 and DHS-28 (*Fig.* 3) are dynamic units with impedances of 600 and 25 ohms, respectively. Net prices are about $39 for the 25 ohm model and $44 for the 600 ohmer. They are also available connected for binaural operation. The Telex, Inc. model D-7 "Dynaset" (*Fig.* 4) consists of a tiny, 6-ohm unit



Fig. 3. Permoflux dynamic headset, with ear cushions.

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feeding a stethoscope-like headset arrangement. Net price is about $9.

The manufacturers' frequency-response curves are reproduced in *Fig.* 5, and give some indication of performance. It will be noted that the Telex "Dynaset" appears to be somewhat deficient in treble response. When using this unit it might be desirable to incorporate a fixed treble-boost network, or to set the amplifier treble control at maximum. In any event, selecting phones on the basis of these curves alone would be sheer folly. For one thing, the response curves of the crystal units were made at constant voltage input, while those of the dynamic phones were specified as having been made at constant power. If the latter had been at constant voltage they would tend to be smoother but with a reduced treble response. Other test procedures may also be different, such as the use of different "dummy ears" and possibly different degrees of averaging the response. But more important is the fact that frequency response is but one of a number of factors influencing fidelity. For this reason the buyer should make a comparative listening test with music, voice and, if possible, an audio oscillator. Only in this way can he determine which headset will please him most. The writer suggests that he visit a large radio supply house with extensive high-fidelity demonstration facilities. If the salesman appears shocked that someone should request to compare earphones, point out (in a polite manner) that speaker comparisons are provided and comparison tests are just as useful and necessary with phones. Even if the first such request is refused, demonstrations will eventually be given if enough people ask.

When making a comparison test, the first and most important thing to do is to listen to music and judge which headset gives the most pleasing tone quality. Play several different musical selections and fiddle with the tone controls. Turn up the volume until the music is as loud as you'd ever care to hear it. Make sure it still sounds "clean." At normal volume, is there adequate treble? Does it sound natural or "strained"? How about the bass? Is it hi-fi bass or table-model-radio bass?

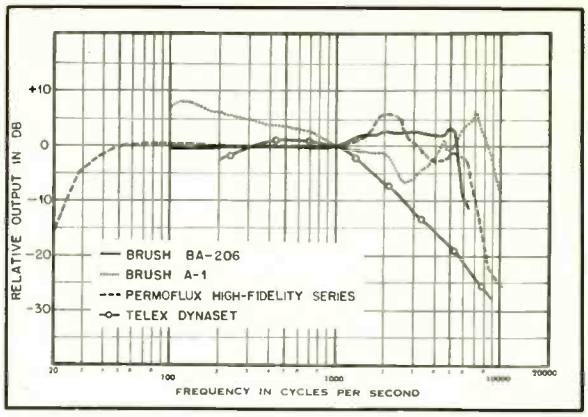


Fig. 5. Frequency response curves for the four types of headsets.

If an audio oscillator is available, run through the frequency range if time and patience permit. Which headset is most free from peaks and dips? Below 200 cps is there any evidence of frequency doubling? How badly does the response fall off between 200 and 50 cps? Between 4,000 and 8,000 cps? (In all these tests it is extremely important that the source impedance be as low as or lower than the impedance of any of the phones. If the lowest oscillator output impedance is 500 ohms and the Permoflux 25-ohm headset or the Telex Dynaset is being tested, an output transformer or line-to-voice-coil transformer should be used.)

Finally, is the headset comfortable? In order to achieve good bass response there must be an airtight seal between the phone and the ear. Is this easy to obtain without too much pressure? If not, sponge rubber ear cushions are available that may help. When these are used, make sure they don't cover part of the opening in the cap or the treble response may suffer. It is sometimes possible to cut a larger opening in the cushion if necessary.

In conclusion, pick the headset that sounds and feels best.

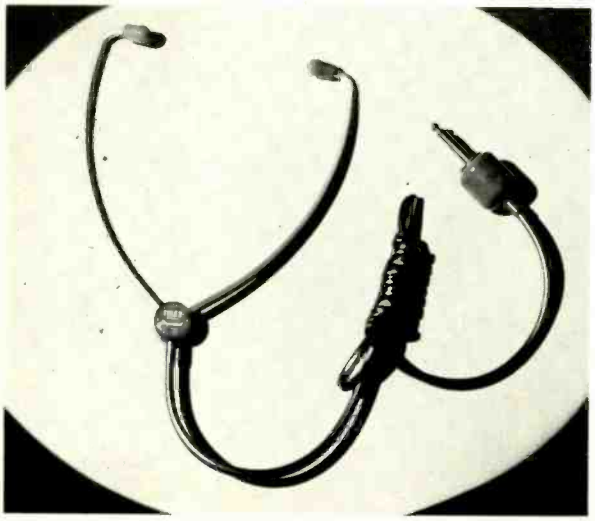


Fig. 4. The Telex Dynaset. The "speaker" unit is located at the plug, and sound is conducted through the thin plastic tube and the pliers-like headpiece to the ears.

Connecting the Phones

Headphones are easily connected to the secondary terminals of the output transformer of an amplifier. It is important to terminate the amplifier with the proper impedance. This is most readily done by shunting a resistor of the proper value across the phones, as in (A) of *Fig.* 6. For example, if 25-ohm phones are to be operated from an 8-ohm output tap, they should be shunted by a resistance of approximately 12 ohms. Many phones have impedance of 500 ohms or more and when these are operated from a low-impedance tap, the shunt resister should be equal to the impedance of the tap since the phone present negligible loading. Operation of phones from a tap of the same impedance rating as the phones is not recommended for two reasons: first, they are so much more sensitive than a speaker that unless the volume control setting is drastically reduced, the phones may be seriously damaged by excessive audio power; and second, except in the most carefully designed amplifiers hum becomes bothersome when the volume control is barely cracked. This is caused not by an increase in hum but by the decrease in audio while the hum originating in stages after the volume control remains constant. The most desirable arrangement is one in which the volume control need not be touched when the speaker is cut out and phones plugged in. If the phones are still too loud when connected to the lowest impedance output tap and shunted by the appropriate resistor, it is possible to use a smaller shunt resistance and a series resistor, the combination having the same impedance as the output tap, as at (B) of *Fig.* 6. A convenient switching arrangement that automatically disconnects the speaker when phones are plugged in is shown at (C).

Connection to the output transformer as described above is often the most convenient method of attachment. Actually, however, the conventional power output stage is unnecessary. A cathode follower or a medium-mu triode such as the 6C4, 6J5, or half a 6SN7 or 12AU7 can provide more than adequate power to drive a pair of phones. This makes it possible to save electricity by shutting off the power amplifier, and the fellow

(*Continued on page 64*)

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Chart of Resistor Values for Loudspeaker L-Pads

H. PETER MEISINGER*

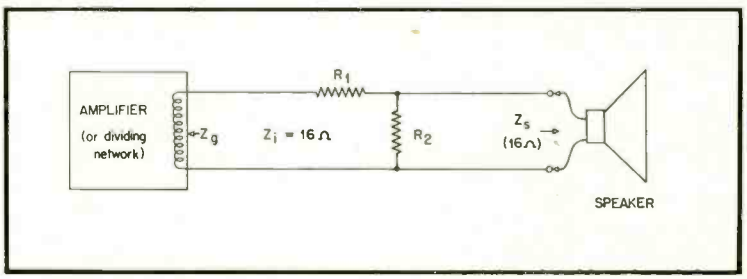
Proper equalization for different efficiencies of the various drivers in multiway loudspeaker systems often requires the use of resistive pads. Values for the resistors and the effect on both driving impedance and damping factor are given in chart form.

CONSIDERABLE INFORMATION has been published regarding the design of crossover networks for use between amplifiers and two- and three-way loudspeakers. However, little has appeared with regard to resistive networks which are often necessary to equalize the efficiencies between the two or more loudspeakers. It is generally recognized that loudspeakers should be driven by generators which have a low impedance. In most cases a zero or negative value of generator impedance is desirable. If one insists upon using a single amplifier with a crossover network and a pad, the old-fashioned "L" pad more nearly meets these requirements than any other configuration.

The "L" pad will provide the crossover network(s) with the necessary proper terminating impedance and in addition will provide the speaker with the lowest generator impedance possible from a resistive network. This is in contrast with the popularly used simple potentiometers which invariably result in equivalent generator impedances several times higher than the amplifier nominal output impedance.

The accompanying chart, Table I, gives the resistor values for "L" networks working between a 16-ohm source and a 16-ohm load. For impedances other than 16 ohms, multiply both resistors by the factor shown in Table II. As a matter of interest, the actual generator impedance as viewed by the speaker is shown for amplifier or crossover network impedances of the nominal value of 16 ohms, or for amplifier impedances of one-tenth the nominal value and of zero.

The last three columns of Table I show the damping factor of the network upon the speaker. From the foregoing it is readily seen that at best, the damping of the speaker is inferior to the case where the crossover takes place ahead of the amplifiers and the speaker and amplifier are directly connected. In the latter case the amplifier generator impedance can be adjusted critically to the value required by the speaker. Damping factor is defined as the nominal load impedance of the amplifier (that is, the speaker impedance recommended) divided by the equivalent generator impedance of the amplifier. The damping factor as shown in Table I is determined solely by the insertion loss of the pad.



* *Laboratory of Electric Engineering, Inc., 413 L St., N.W., Washington, D.C.*

TABLE I

LOSS DB	RESISTOR VALUES FOR "L" PAD		SOURCE IMPEDANCE SEEN BY SPEAKER FOR Z_g VALUES OF			DAMPING FACTOR PRESENTED TO SPEAKER BY PAD FOR Z_g OF		
	R_1	R_2	16Ω	1.6Ω	0Ω	16Ω	1.6Ω	0Ω
1	1.74	131.12	15.5	2.45	1.72	1.03	6.53	9.30
2	3.29	61.79	14.7	4.55	3.10	1.09	3.52	5.16
3	4.67	38.78	13.4	5.35	4.25	1.19	3.0	3.70
4	5.90	27.35	12.1	5.90	4.85	1.32	2.71	3.77
5	7.00	20.55	10.8	6.05	5.22	1.48	2.64	3.06
6	7.98	16.07	9.6	6.00	5.30	1.67	2.66	3.02
7	8.85	12.91	8.5	5.80	5.43	1.88	2.76	2.95
8	9.63	10.58	7.5	5.40	5.05	2.13	2.96	3.17
9	10.32	8.79	6.6	5.05	4.73	2.43	3.17	3.38
10	10.94	7.39	5.6	4.64	4.41	2.86	3.45	3.63

TABLE II

WHEN Z_i IS OTHER THAN 16 OHMS MULTIPLY R VALUES BY Z_i ÷ 16	
4	0.25
6	0.375
8	0.5
15	0.9375
20	1.25
32	2.0
250	15.625
500	31.25

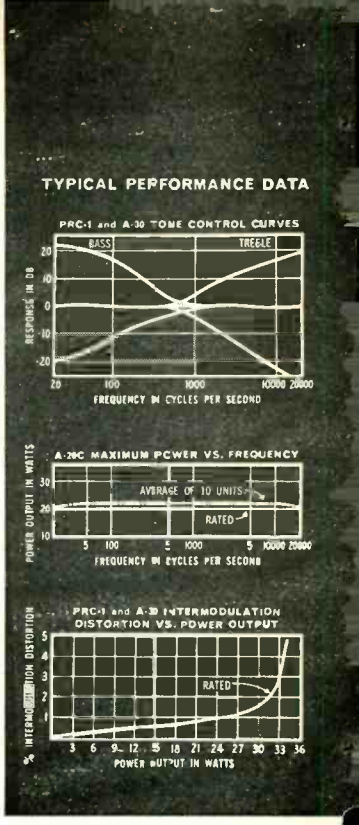
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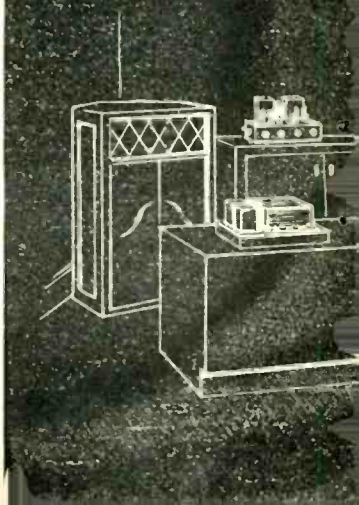
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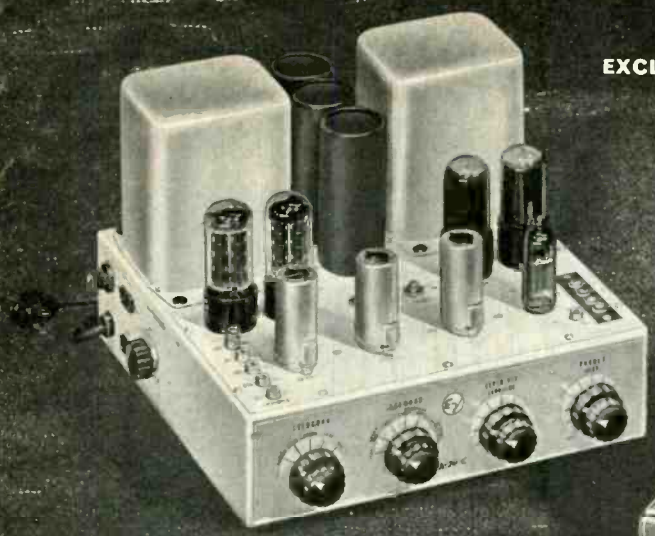
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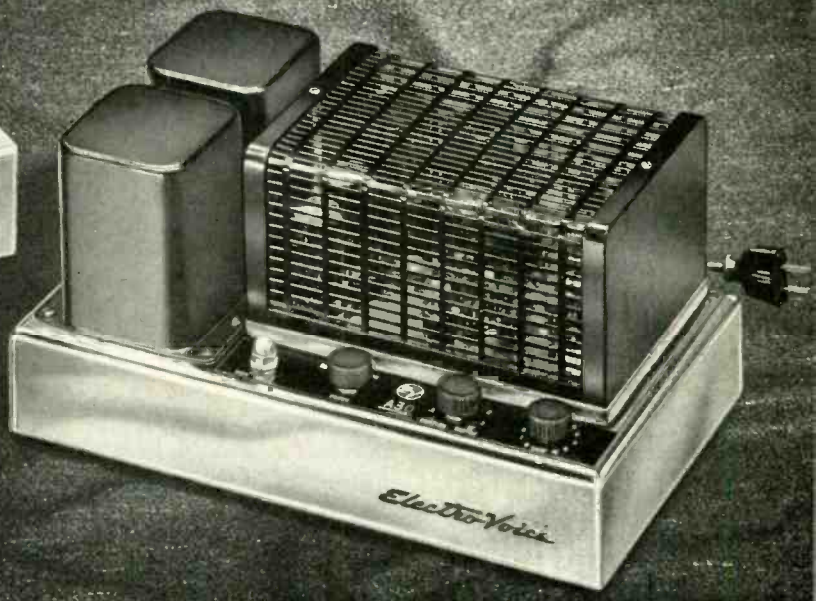
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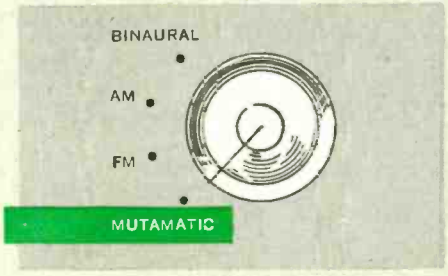
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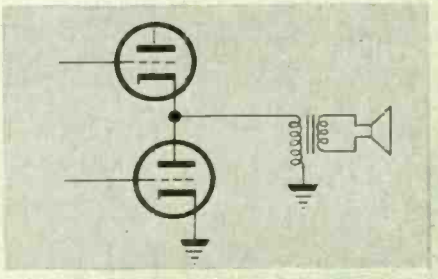
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Motor Rumble Reduction in Wide Range Phonographs

JOHN R. CATER*

A negative-feedback-type R-C filter, the author finds, is the only way to banish table rumble permanently and completely, short of acquiring a broadcast-studio unit.

MUSIC LOVERS, who have striven to approach perfection in their reproducing systems and have lavished much money and mental anguish in the effort may wonder to what end they have achieved excellent bass response when it brings up motor rumble to an intolerable level. Of course, there are turntables available with extremely low rumble, but they are bulky and they cost several hundreds of dollars. Even some turntables selling for more than $100 have very annoying rumble.

The nature of rumble suggests a solution. Many phonograph motors have four poles. These motors rotate at 1800 rpm if they are synchronous, and around 1725 rpm if they are induction motors. Rumble results from mechanical and electrical imbalances in the motor which cause a variation in speed once per revolution, or 30 and 28.7 times per second. It is a rare record indeed (not counting test records) which has such low musical notes. A narrow-band frequency-rejection filter centered on the rumble frequencies will wipe out the rumble without affecting the useful output of the vast majority of records.

Figure 1 shows such a filter. It employs a cascode amplifier V_1 with a parallel-T network in a feedback loop. It is absolutely essential that the components of this twin-T be both accurate and stable. It is well to measure them rather than trust the marked or coded values. Since the ganged potentiometers R_4 have only 10 per cent of the values of the fixed resistors with which they are in series, they may be considerably less accurate and stable without causing trouble. From a group including one IRC Q11-123 potentiometer, and six M11-123 "multisections," the writer was able to select a set with a maximum tracking error of 5 per cent (based on full resistance value). Two 50,000- and one 25,000-ohm potentiometers are required. Less tracking trouble will be experienced if two 50,000-ohm units are connected in parallel to obtain the 25,000-ohm value. R_1, R_2 and R_3 are 1 per cent tolerance deposited-carbon-film resistors. Most composition resistors are likely to age too much to be satisfactory. C_1, C_2, C_3 and C_4 are silver mica capacitors chosen for 2 per cent tolerance.

The values chosen permit the center frequency to be adjusted sufficiently in most cases by simply setting R_4. Referring to *Fig.* 2, the null frequency for this network is $1/2\pi R$, and for the values selected, ranges from 32 to 28.9 cps. If it desired to lower this range of frequencies, it may be most conveniently done by adding parallel capacitors across C_1 and C_2 in *Fig.* 1. Since the parallel capacitors will be small in comparison to C, they need not be silver micas. If the components give too low a frequency when properly matched, the null frequency may conveniently be raised by shunting R_1, R_2 and R_3 (*Fig.* 1) by appropriate resistors.

In the cascode amplifier V_1, the gain for signals into the grid of V_{1a} is equal to $\frac{\mu R_L}{R_L + [(\mu+2)R_p]}$. For signals into the grid of V_{1b}, the gain is approximately equal to $G_m R_L$ and is much larger in value than for V_{1a}. Since the signal applied to V_{1b} is degenerative, there is a very appreciable loss in signal level at the output of the filter, but the effective Q of the twin T is greatly increased. Because of the loss (approximately 30 db), the signal from a low-level pickup must be passed through a preamplifier first, though the output from high-level units such as the Weathers FM pickup oscillator may be passed through the filter without further amplification.

It is usually desirable to bring the level up again immediately. One triode section is sufficient (V_{2a}) and if double triode is used, there is one section available (V_{2b}) for a cathode-follower so that output cable capacitance may be neglected.

Cascodes and cathode-followers place an undue burden upon heater insulation unless appropriate steps are taken. The heater-cathode rating of most tubes is 90 volts. If the heater supply is biased 90 volts above ground, grounded cathodes are still within rating, and cathodes operated at high voltages may reach

(*Continued on page 67*)

* *108 Warren St., Nutley 10, N. J.*

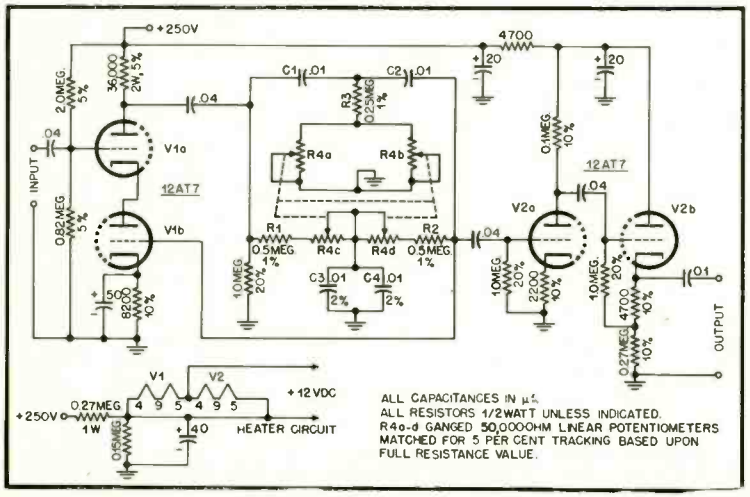


Fig. 1. This is the rumble filter, turnable to between 28.9 and 32 cps. Note carefully that the ganged potentiometers must be matched for tracking. R_1-R_3 and C_1-C_2 should also be checked, preferably with a bridge.

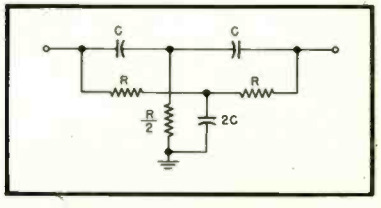


Fig. 2. The parallel-T network.

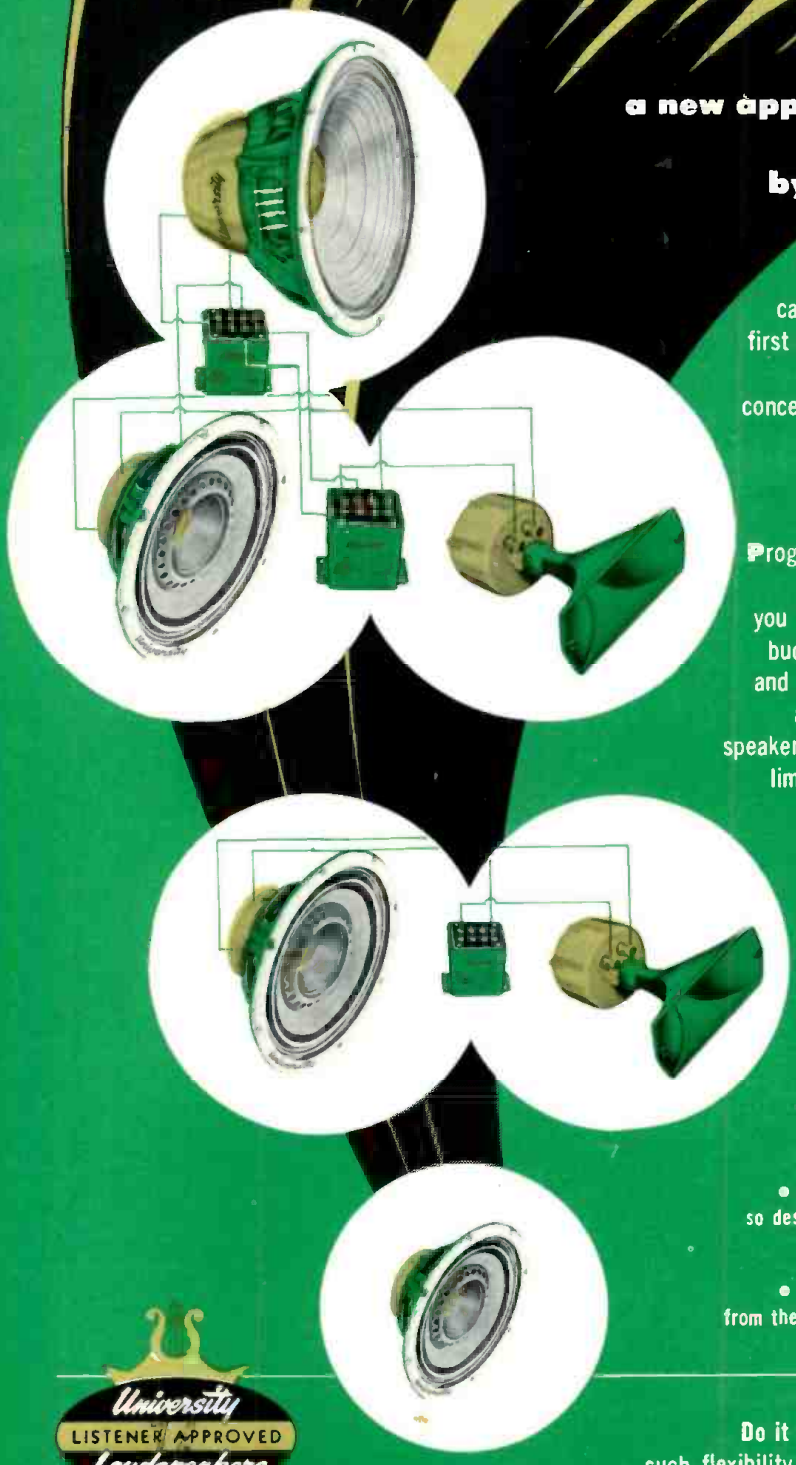
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The Dean. For use in a corner or equally efficient flat against a wall. You'll be amazed at the results from the C15W 15" woofer, Cobreflex-2 with T-30 driver for the mid-range and the HF-206 for the highs. N-3 network used to cross over at 350 and 5000 cycles. The enclosure is a newly designed compression type folded front-loaded horn so completely independent of the walls and floor of a room that it is truly the one and only "cornerless corner" cabinet. By unique internal design, wasted space has been eliminated so that the overall dimensions of this sensational system are only 36¼" high, 36" wide, 22" deep. Available in Cherry Mahogany or Blond at no extra cost. Impedance 8 ohms, power capacity 50 watts. The DEAN enclosure is available separately as Model EN-D in Cherry or Blond.



The Classic. Containing the incomparable C15W 15" woofer, Cobreflex-2 with T-30 driver for rich full-bodied middles, the new HF-206 Super Tweeter and the N-3 network complete with "Brilliance" and "Presence" controls, the Classic incorporates some of the finest University engineering achievements. The enclosure is the versatile, newly designed folded front-loaded horn which operates the C15W woofer as a compression driver for maximum efficiency. Due to this design, the acoustic performance of the CLASSIC is independent of the walls and floor of the room and may be used either as a "lowboy" console or "highboy." Base is adjustable for this purpose. Dimensions: 34½" x 40½" x 24¾". Available in Cherry Mahogany or Blond at no extra cost. Impedance 8 ohms, power capacity 50 watts. The CLASSIC enclosure is available separately as Model EN-C in Cherry or Blond.



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The EN-15 is equipped to mount either a 12" or 15" coaxial or triaxial speaker. Accommodation has also been made to take University mid-range and high-frequency reproducers for use in 2 or 3 way combinations. A 12" woofer such as the C12W Adjustable Response Low Frequency Reproducer, or the Dual Impedance Range C15W 15" woofer may also be used.

Made of heavy, fully-cured woods throughout and finished on 5 sides, the EN-15 may be used in either a corner or flat against a wall. Available in Cherry or Blond Mahogany at no extra cost. Dimensions: 37" x 28" x 19¼".

EN-8 Mighty Midget. Hit of every Audio Fair across the nation, University now makes available this special 8" speaker enclosure which was originally designed to demonstrate the remarkable Diffusicone-8 coaxial speaker. Incorporates combination rear horn loading for unexcelled power handling and distortion control, and tuned horn mouth for phase inverter action for increased bass efficiency. Only 25⅝" x 18" x 12".

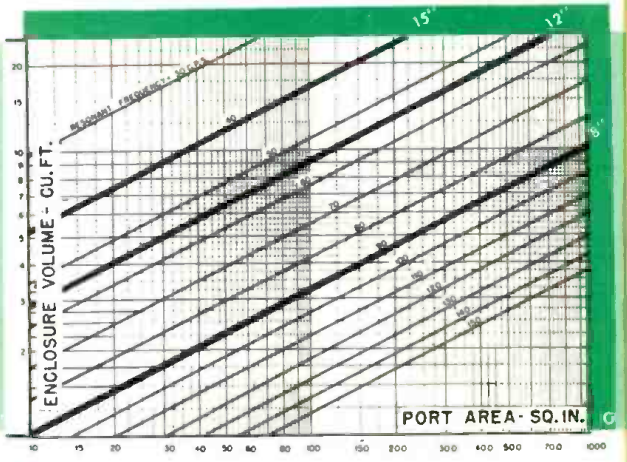
The EN-8 may be used ideally with the new Model 308 Triaxial speaker. It also has cut-outs for the 4401 tweeter and C8W 8" woofer combination, if desired. Available in Cherry or Blond Mahogany at no extra cost; also in unfinished Mahogany.

When Building Your Own Bass Reflex Cabinet . . .

Popularity of the bass reflex type baffle is due to its relative ease of construction, small space requirements, and satisfactory overall performance. Decide upon the dimensions of the baffle to be built, in accordance with physical requirements, but try to keep the inside depth of the cabinet to not less than 12". All sides should be made of heavy, seasoned wood (preferably ¾" plywood). All corners must be thoroughly braced to prevent buzz noises at cabinet resonance. The removable side (usually the back) should be secured at the corners, as well as approximately every 4" along the edges. All of the back side and fifty per cent of the remaining inner surfaces of the cabinet should be lined with a sound absorptive material, such as celotex, rockwool, etc.

Tuning the Port. The port of a bass reflex baffle is considered properly tuned for best low frequency response of the speaker system when the bass response has been equalized and spread out over as wide a range as possible. Peaking or excessive boominess is an indication of an improperly dimensioned port.

The chart shown indicates optimum port area for given cabinet volumes and loudspeaker free air resonances. Once the port area is determined, the actual dimensions will not be found to be critical. The heavily shaded lines on the chart are for use with the size University speakers indicated.



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The new Fairchild 240 is the result of extensive engineering research and an elaborate series of listening tests designed to discover and overcome weaknesses in existing preamplifiers.

These theoretical and engineering studies have brought into reality this great new idea in high fidelity amplification—THE NEW FAIRCHILD 240 BALANCED-BAR PREAMPLIFIER!

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BALANCED-BAR CONTROL—this great Fairchild innovation allows you to match tonal balance between your high fidelity system and the acoustical properties of *your own* listening room . . . automatically!

LISTENING LEVEL CONTROL—provides the most pleasant low-level listening you ever heard! *Plus* correct balance at normal listening levels—all achieved without complex adjustments or loss of control by operator. And the amazing LLC operates independently of volume control!

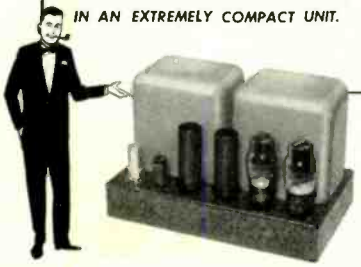
HIGHEST GAIN—LOWEST NOISE—achieved by modifying famous radar and TV cascode input circuit to audio amplification and by careful design, using highest quality components.

See the wonderful Fairchild Balanced-Bar Preamplifier today! An extraordinary achievement in performance, cabinet design and operating simplicity! Better audio dealers everywhere are proudly presenting the 240 . . . the greatest preamplifier ever produced . . . at only $98.50

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Second Annual AE Award Goes to CINERAMA

Lester B. Isaac, director of exhibition, jointly honored at presentation on occasion of second anniversary of Cinerama showing on Broadway and beginning of third year. Cinerama's president Hazard E. Reeves also honored by Society of Motion Picture and Television Engineers at semi-annual banquet.

WITHOUT ANY ADVANCE PUBLICITY, AUDIO's second annual audio engineering award was presented to Cinerama and to Lester B. Isaac at a short celebration held in the lobby of the Warner Theatre in New York on September 30—the second anniversary of Cinerama's showing on Broadway. The citation on the award reads as follows:

THE SECOND ANNUAL AUDIO ENGINEERING AWARD—*for the tremendous role played by Cinerama in the development and advancement of true sound is awarded to CINERAMA and to Lester B. Isaac, director of exhibition for Cinerama.*

BECAUSE *"This is Cinerama" is celebrating the beginning of its third year on Broadway after a remarkable record of two successful years, and*

BECAUSE *the Cinerama medium ushered in a new era in motion sound, and*

BECAUSE *"This is Cinerama" has given countless millions a new appreciation of the importance of true sound as exemplified by the Cinerama process.*

Sanford L. Cahn, advertising director for AUDIO, presented the award plaque to Mr. Isaac in recognition of the new era of stereophonic sound which is Cinerama. While the work resulting in Cinerama as we know it took place well before 1953—the period normally scanned in determining the Æ award winner for 1954—it was felt by AUDIO's staff that the remarkable acceptance of Cinerama well merited the magazine's annual honor.

Awards for 1952—presented in May 1953—went to Sonotone Corporation for its Model 1010 transistor-tube hearing aid; to Thomas A. Edison, Inc. for the Edison VP Voice-writer, and to six recording companies for eleven categories of records.





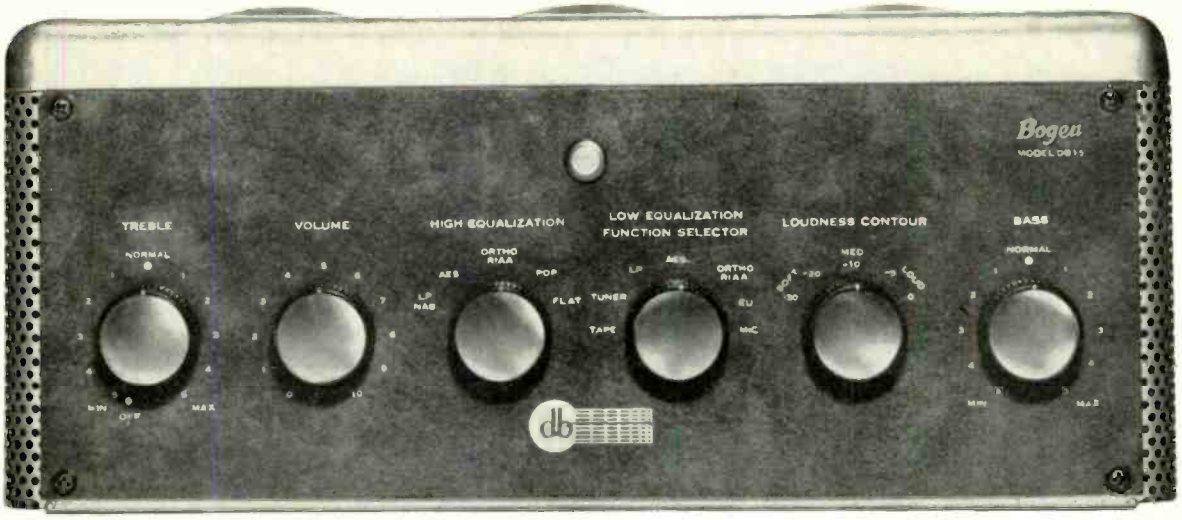
Above: Lester B. Isaac (left) receives award plaque from Sanford L. Cahn of AUDIO at second anniversary celebration in New York on September 30. Below: Hazard E. Reeves (right) receives fellowship certificate from Herbert Barnett, president of the Society of Motion Picture and Television Engineers.

Cinerama's president Hazard E. Reeves—who is also president of Reeves Soundcraft Corp. and of Reeves Sound Studios—was further honored at the semi-annual banquet of the Society of Motion Picture and Television Engineers in Los Angeles on October 20, when he was tendered a certificate certifying his election as a fellow of the society. The SMPTE board of governors voted unanimously to make him a fellow in recognition of his major status in the motion picture and television industries and for his substantial contribution to the betterment of the industry.

The Magna-Stripe process used by all the major movie studios in making magnetic release prints of movies photographed by the CinemaScope process is a development of Reeves Soundcraft Corporation.

At the same banquet, a fellowship was presented to Mr. Isaac—making it a banner year for Cinerama. Others who received fellowships at the same time were Harry F. Olson, Richard H. Ranger, Philip G. Caldwell, John R. Clark, Jr., Albert A. Duryea, Ralph H. Heacock, Armin J. Hill, U. B. Iwerks, George Lewin, Everett Miller, Reid H. Ray, Ralph A. Teare, R. Edward Warn, and James L. Wassell.

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A Little Fellow with a 15 Watt Wallop

BOGEN DB15G AMPLIFIER

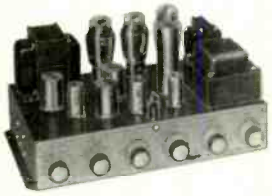
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Perfect companion for high-performance amplifiers, this tuner is especially designed to avoid duplication of controls and to fit neatly into close quarters. Features high sensitivity (5 microvolts), high selectivity, negligible distortion and flat frequency response (within 1 db from 50 to 15,000 cycles on FM). A special, controllable AFC circuit prevents drift and simplifies tuning. **R640G**—*Tuner in Cage. Matches DB15G. Only 13½" x 9" x 6¼".* $112.95. **R640**—*Same tuner without cage. The ideal mate for DB20, DB15 or DB10A amplifiers when installed in cabinetry. 13¼" x 7¾" x 5½".* $105.50.

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The magnificent DB20 is rated the "Best Overall Quality" by a leading consumer organization as well as by thousands of audiophiles all over the world. The DB20 combines 20 watts of undistorted power with remarkable flexibility of control. Even at full rated output distortion is only 0.3%! Other features include the exclusive 5-position Loudness Contour Selector, a 10-position input selector—phono-equalizer, output jack for tape recorders, and extremely effective non-resonant separate tone controls. $99.00.

DB20DF. The DB20 is now available with the new exclusive Bogen Variable Damping Factor. This built-in control provides cleaner bass response by reducing speaker distortion and "tuning out" resonant peaks. $108.00.

BOGEN DB10A AMPLIFIER



Here's Bogen's famous DB10A, priced to fit any budget. This compact marvel of tone delivers 10 watts of power at less than 3% distortion and has a flat frequency response (plus or minus 1 db) from 30 to 18,000 cycles. In addition to a built-in phono preamplifier, the DB10A features a special tape recorder output jack and a 3-position equalizer for LP, 78, and Pop. $54.45.

Note: All prices slightly higher in the West.



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Simplexing a Standard Amplifier For Dual-Channel Operation

R. S. HOUSTON*

An old telephone-line is applied to a standard push-pull amplifier to provide an auxiliary channel with only minor changes in the circuitry of the existing unit. Applications for such a device are myriad, and the ingenious experimenter will find many uses for it.

YEARS AGO when the vacuum tube was in its infancy and price put it out of reach of most people, engineers and experimenters devised various ways to reduce the number of tubes in a circuit without impairing its perfomance. Back in those days, the only type of tube available was a single-section triode with a directly heated cathode. This obviously did not lend itself to trick circuits using various configurations of internal element construction, as many of our multipurpose tubes do today.

One very notable effort in the conservation of tubes was the development of the reflex circuit, which used the same set of tube elements for several purposes. In receivers, the signal was fed through a tube at, say, the incoming radio frequency. Then after detection, it was again fed through the same tube for audio amplification. Thus the circuit lived up to its name. The signal was effectively reflected back through the tube. If bypassing was right, there was no interaction between the circuits, and each could be handled separately.

This same principle of feeding different types of energy through one stage of amplification is used today in various types of microwave systems for remote control, telemetering, and numerous other applications. The effect is not that of true reflexing, of course, since none of the signals are related, but the principles are the same.

On telephone lines, even before the advent of carrier systems, multiple use was made of the lines by means of phantom and simplex circuits.

Phantom and simplex circuits are ways of creating an extra transmission channel almost "out of thin air" as illustrated in *Fig.* 1. In (*a*) is shown an ordinary telephone line of the type used to carry program material or voice communication between the studio and a remote pickup point or the transmitter. The line is normally ungrounded and is terminated in transformers at each end. It is balanced to ground and to other pairs in the cable simply by virtue of being twisted throughout its length.

In *Fig.* 1 (B) appears the simplex connection. Each transformer of the original line T_1 and T_2 is provided with a centertap. An additional transformer T_3 and T_4 is connected between the centertap and ground at each end and an additional channel exists between the two extra transformers. The connection between the upper ends of T_3 and T_4 is the two wires of the line. but since the audio currents are in phase on the two wires (assuming the centertaps to be accurate) audio from the simplex channel does not make itself apparent in the original channel.

Figure 1 (C) shows the phantom connection. Instead of a ground return for the bottom of T_3 and T_4 a second line which runs to the same points is centertapped T_5 and T_6 and the phantom line is balanced to ground and the other pairs just as are the original lines. In both cases the balance of the original lines is not disturbed if centertaps are accurate. The phantom and simplex circuits are really that almost unattainable object—something for nothing!

This effect is identical to the cancellation of the magnetic field in the primary of a push-pull transformer carrying d.c. for the plates of the tubes. In a properly balanced push-pull amplifier, it is possible to have a rather high hum content in the power supply without hum appearing in the output. Conversely, a

* *7723A Broad St., Pennsauken 8, N. J.*

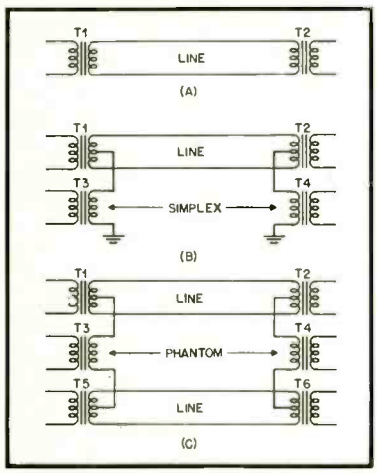


Fig. 1. For years broadcasters have been simplexing and phantoming standard phone lines to provide an extra cueing or transmission channel.

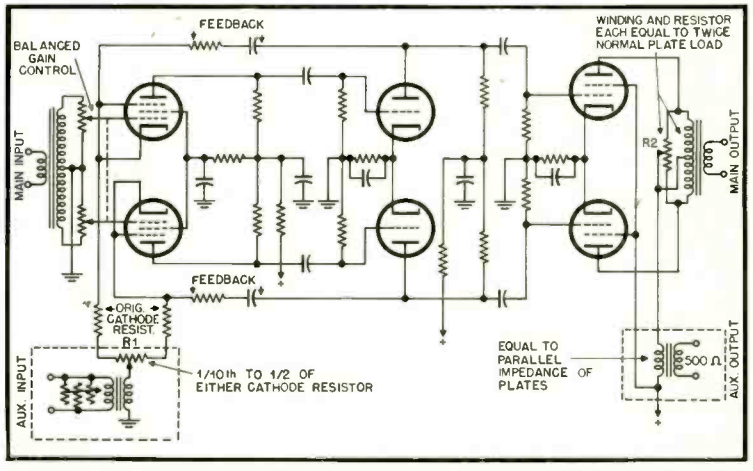


Fig. 2. The original monitor amplifier in the control console was modified by addition of the components in dashed boxes to provide a second, simplexed channel analogous to the scheme of Fig. 1 (B).

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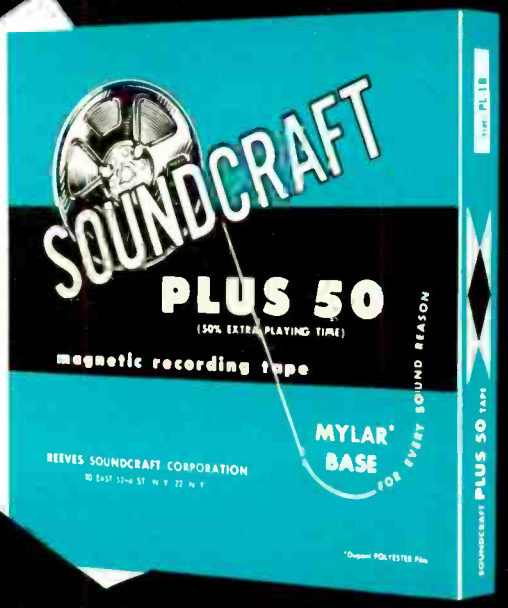
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(50% EXTRA PLAYING TIME)

magnetic recording tape



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- FULL DEPTH OXIDE COATING
- . . . YET COSTS NO MORE

PLUS 50 is the *perfected* "long-playing" magnetic tape, bringing you *50% extra* playing time with no compromise in strength or recording quality.

One reel of "Plus-50" is equal in recording or playback time to 1½ reels of standard tape. More listening per reel . . . less time changing reels. Best of all, Soundcraft "Plus-50" *actually costs less per foot* than quality acetate-base tapes!

The secret of "Plus-50" lies in its extra thin "Mylar" base (1 mil as compared to 1.5 mils in acetate tapes). "Mylar," DuPont's Polyester Film, contains no plasticizer. It will not cup or curl. Elongation and shrinkage from heat, cold and humidity are barely measurable. And it's far stronger than the thicker acetate . . . one third as strong as steel!

There has been no compromise in the development of "Plus-50"—a big advantage for you! The oxide coating is *constant, full-depth*—to maintain correct frequency response, output level, and bias characteristics. No machine adjustments are needed. "Plus-50" can be interspliced with other fine quality tapes without level change.

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very wide excursion of the plate current in either tube will not appear as a current change in the power supply. The two functions are effectively isolated.

By combining these two functions into an amplifier, it is possible to obtain in a standard push-pull amplifier two channels completely independent of each other, with very few extra components or changes.

Theory of Operation

A study of *Fig. 2* will reveal nothing more complicated than a three-stage, push-pull, high-gain amplifier with balanced feedback over two stages. In this discussion the example used is the monitor amplifier section of the speech-input console, but any other type of apparatus is equally adaptable. The parts enclosed by the dotted lines are the additions made to effect the two-channel system.

In regular operation, a signal is fed across the terminals of the balanced gain control and thence to the grids, and amplified in the usual manner. The grid return normally comes from the ground connection on the low-potential side of the control. However, if a transformer secondary or other form of coupling is connected in series with this ground connection, it will be possible to feed a signal into the grids of both tubes, with the two grids in phase.

An alternative way, the one illustrated, is to make a cathode amplifier (for the second channel) out of the first stage. This was found the most expedient way to avoid too much rebuilding in order to prevent the regular input gain control from acting as a master control for both channels, as would happen in the case of the grid-return-input arrangement. With a cathode-fed amplifier, the grid of the tube normally is grounded. In this case it is impossible, but the degeneration caused by having resistance in the grid is slight. There is some interaction when the control is moved, causing the degeneration to go down as the control is moved toward ground, but again this effect is slight; the amplifier was used only for utility, so the gain was not too critical.

Because there is no need for bypassing in a well balanced push-pull amplifier, there is no danger of the main signal being impressed on the auxiliary signal through the cathode input circuit. However, even in the best amplifier, it is impossible to prevent unbalances from occurring from tube and component aging. Therefore it was found expedient to install the variable resistor R_f in the cathode for obtaining the centertap. This will enable the drive on each side to be properly balanced to compensate for any unbalances in any stages from input to output, thus keeping the two channels isolated.

It is also necessary to have a variable centertap R_s across the output circuit, to obtain perfect balance in both channels. The output tap compensates for any unbalance in the main signal, preventing it from leaking into the auxiliary circuit. In balancing the system, a signal is fed into the main input at the normal level and a monitor is placed across the auxiliary output. The output tap is then adjusted to give zero output in the auxiliary circuit. The connections are then reversed, with the signal feeding the auxiliary input at its normal level, and the monitor on the main output. The input tap adjustment is made until there is no sound heard in the main output. In order to prevent any unbalances from occurring, it would be well to check the balance every time the tubes are checked. Rebalancing will probably be necessary when the tubes are changed.

Since the presence of a transformer any place in the circuit will cancel the coupling of the auxiliary signal to the next stage, it is necessary that all intermediate stages be resistance-coupled, or that some coupling system be employed between the centertaps on the primaries and secondaries of the transformers involved. This fact might be used, however, to tap off the auxiliary signal at an earlier stage than the output in case the full gain is not required. This will not affect the operation of the other stages for the main signal in any way. In coupling the output, either at the output stage or ahead of it, any method may be used. However, using a transformer is doubtless the best way. All that is necessary is to connect the primary in series with the d.c. lead going to the centertap of the normal output transformer as shown in *Fig. 2*. The effect of the amplifier upon the auxiliary circuit is that of the tubes of each stage being connected in parallel as single-ended stages. Therefore, although the average plate current does not change for the main signal, the auxiliary signal causes a change. Since this current also appears in the cathode, it is necessary to have bypasses in the cathode equivalent to those necessary for a normal single-ended stage. Greater decoupling is required in the power supply than would be necessary with a normal push-pull amplifier.



And that's their portable model . . . with handles!

Although an interstage transformer will prevent coupling of the auxiliary signal to the next stage, it is not necessary to insert a transformer in an earlier stage of a resistance-coupled amplifier if it is desired to recover the auxiliary signal at that point. Since the plate currents of all stages reflect the characteristics of both signals, it is only necessary to put a coupling circuit in the B-plus lead of the stage desired. The auxiliary signal will still be coupled to the next stage, but at the output it will be lost. there being no coupling circuit to recover it. Thus, it is unnecessary to change the configuration of the amplifier to accomplish any function.

Notes on Application

There is one point which must be noted in connection with the simultaneous operation of the channels. If either of the signals drives the amplifier toward maximum output, it is necessary to reduce the level of the strongest one about 3 db. This brings the maximum output of the amplifier down to half its rated capability. If this is not done, the combined level of both signals drives the tubes into the distortion zone. In normal applications and with conservatively designed units, this precaution is not necessary.

The original purpose of the dual-channel conversion of the control console was to fill a need for extra amplifiers. Previously, a recorder amplifier had been used as a utility unit, feeding lines, network booster, etc. With the recording schedule getting heavier, oftentimes the amplifier was not available when needed for other purposes. Now there are two extra channels available at all times, the changes having been made eventually to the program amplifier also. The cost was zero, because the necessary transformers were on hand, as were the few other parts.

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Equipment Report

Shure "333" High Fidelity Studio Microphone—The R-J "Wharfedale" Loudspeaker—Brociner UL-1 Ultra-Linear Amplifier, CA-2 Control Unit, and A-100 Preamplifier—Rauland 1811 Amplifier

SHURE "333" MICROPHONE

Reports of this nature on such items as microphones and loudspeakers must necessarily be subject to some criticism because it is not practicable to make measurements of absolute characteristics without elaborate acoustical equipment—an anechoic room, calibrated loudspeakers for testing microphones or calibrated microphones for testing loudspeakers, and laboratory-type measuring equipment—but the observations of trained ears can often supplement the measurements supplied by the manufacturer, and in any case such observations will serve to verify advertised claims. Thus it is with some trepidation that these comments are offered, even though it is felt that they are reasonably valid.

Having some familiarity with the earlier Model "300" Studio Microphone and being thoroughly familiar with its characteristics on both music and voice, we were pleased at the opportunity to put the "333" through its paces. The "300" is a conventional ribbon microphone—referred to by the manufacturer as a "pressure gradient" type—with excellent frequency response, nearly complete cancellation at the sides, and reasonable freedom from wind and "p" noises. We have used this model for many months in numerous applications, and have found it to be responsive to loudspeaker-emitted frequencies up to 22,000 cps—indicating a signal on the VU meter at the output of an amplifier as the tone was keyed on and off, even though no signal could be heard (by this observer) in the room at that frequency. The "300" has been used for all speaker measurements reported here, and has been found excellent for the purpose.

The new "333" is described as a unidirectional ultra-cardioid unit. It consists of a horn-loaded ribbon transducer coupled with a newly-designed phase-shifting network which reduces reverberation, reflection, and undesired random sounds by 73 per cent as compared to a non-directional microphone.

Pickup is uniform within ±3 db over an angle of 160 deg., with direct pickup from the rear down approximately 13 db from that at the front. Two null points are noted extending roughly from 120 to 150 deg. from the front on either side, and it is as a result of this type of pattern that over-all pickup is reduced by so large an amount.

Comparative listening between a known reference loudspeaker and a signal picked up from the speaker and fed to another provides a means for checking the frequency response. The "333" reproduces the picked-up signal with good fidelity, giving the characteristic recognized as "high fidelity" by those familiar with studio-quality broadcast microphones. There is no coloration of the sound which is indicative of peaks, and the output appears to be flat throughout the entire audio spectrum.

Characteristics

The body of the microphone is small—measuring only 3-11/16 in high, 1-7/32 in. wide, and 1-7/8 in. deep, which is in accordance with the current trend for inconspicuous microphones for TV applications. The case contains a matching transformer with three output impedances—35–50 ohms, 150–250 ohms, and high, which computes from the voltage output at approximately 50,000 ohms, but which is designed to be loaded with 100,000 ohms. A concealed switch at the rear of the microphone case selects the desired output impedance. A voice-music switch located in the shock-mounting housing in the base of the unit connects a small inductance across the low-impedance section of the transformer secondary when in the VOICE position. This reduces low-frequency response approximately 6 db at 100 cps, and serves to improve crispness of voice reproduction when used to close the mouth, as microphones are often likely to be used. A male 3-wire Cannon type XL connector is built into the base, with signal leads isolated from ground throughout. The cable shield carries the microphone case ground back to the amplifier.



Fig. 1. The Shure "333" Cardioid Microphone.

Experimentally, we attempted to take advantage of the cardioid characteristics of the microphone by placing an interviewee at the sensitive side and the interviewer at the back. In many instances, the interviewer, with more confidence in microphone technique, will use a stronger voice than the less experienced person with whom he is talking. While this technique would undoubtedly work if both persons were out in the open and without the presence of reflecting elements such as walls, furniture, and so on, it failed miserably in a typical room. The effect was as though the two people were at greatly different distances from the microphone—the interviewer appearing to be considerably farther away than the interviewee. This test serves to show, however, just how effective the reduced pickup from the back is, and offers a quick lesson in microphone technique. Talking at a constant volume close to the microphone as it is rotated around its axis shows instantly—without need for measuring equipment—that there is a very definite reduction in response at the back. In actual use in typical night club or studio surroundings for voice reinforcement, the reduced sensitivity at the rear permits an increase in sound output of 10 to 12 db as compared to a non-directional unit, and an increase of approximately 6 db over the output from the "300" ribbon microphone.

The "333" is a professional unit throughout, and consequently is relatively expensive. Many users of microphones might not be able to justify the cost, but those who are fortunate enough to have access to "live" musical groups for recording will undoubtedly find that the quality of the resulting tapes would easily warrant the additional expenditure. The extra sound output resulting from the cardioid characteristic often dictates the choice of this type of microphone in critical applications where acoustic feedback is extremely troublesome, and for this use the "333" is considered extremely suitable.

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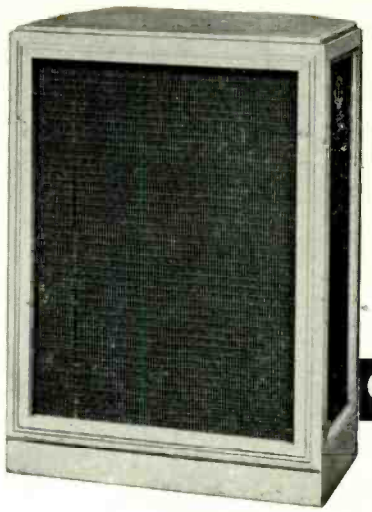
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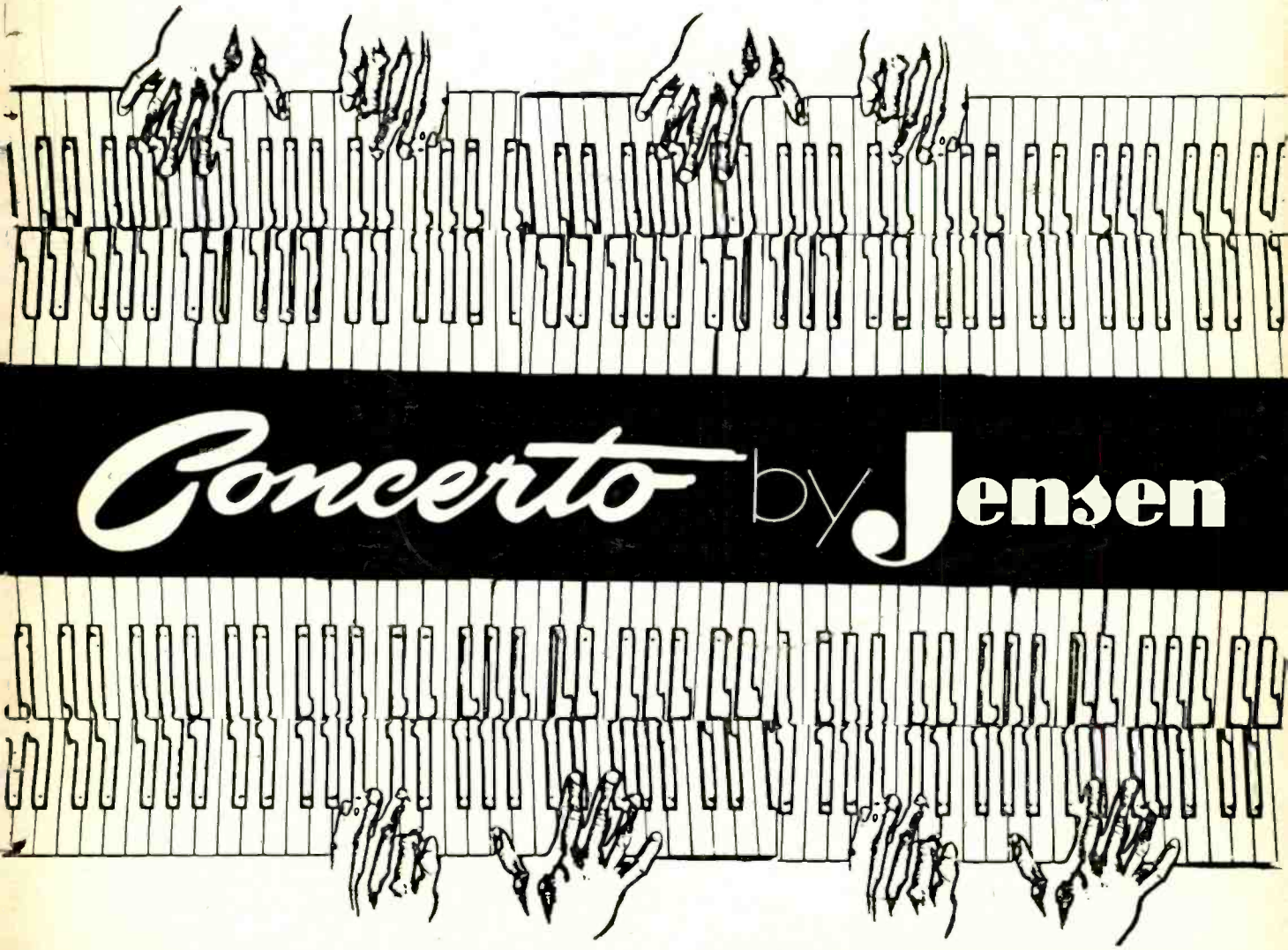
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Equipment Report (Cont'd)

THE R-J "WHARFEDALE"

Ever since the R-J enclosure made its bow on the U. S. audio scene back in 1951, this unit has continued to lead the small-speaker field in popularity. The R-J was the first enclosure to take advantage of the Helmholtz principle and harness it satisfactorily, and there is no denying that good bass response is heard from a box that would have been scorned as a housing for a quality loudspeaker five years ago.

One of the major disadvantages of any loudspeaker enclosure is that it is usually sold separately without any particular speaker mechanism being furnished with it. The same objection obtains as regards speaker mechanisms—in most instances they, too, are sold without a specific enclosure. By some experimenting, suitable performance can be obtained with combinations of some enclosures with other mechanisms, and—fortunately for hi-fi buyers—this has been worked out effectively by most of the audio distributors. Several models of loudspeakers have been found to work exceptionally well in R-J cabinets, and their users are apparently happy with the results.

This hit-or-miss combination of cabinet and loudspeaker has been eliminated with the introduction of the R-J "Wharfedale," for this unit is supplied complete—speaker and enclosure—matched exactly to each other. This unit, shown in *Fig.* 2, is 11 in. high, 10 in. deep, and 23½ in. long, and is available in Mahogany or Korina veneers, in hand-rubbed dark or blonde finish. It is of a size that fits easily into the average bookshelf, making an unobtrusive source of sound. The grille is formed of Expamet—an expanded aluminum sheet, gold anodized—which is acoustically transparent, and stiff enough to resist vibration in addition to being attractive in appearance.

It is equipped with a special Wharfedale speaker mechanism, made especially for this unit. It has a flux density of 10,000 lines, and its aluminum voice coil is wound to an impedance of 10 ohms. The over-all response range is from 50 to 16,000 cps, with audible output down to 32 cps or less, and some measurable output up to 18,000 cps. Considering that the lowest fundamental encountered in music is 40 cps, this enclosure-and-speaker combination provides musical reproduction which is more than adequate for the average home.

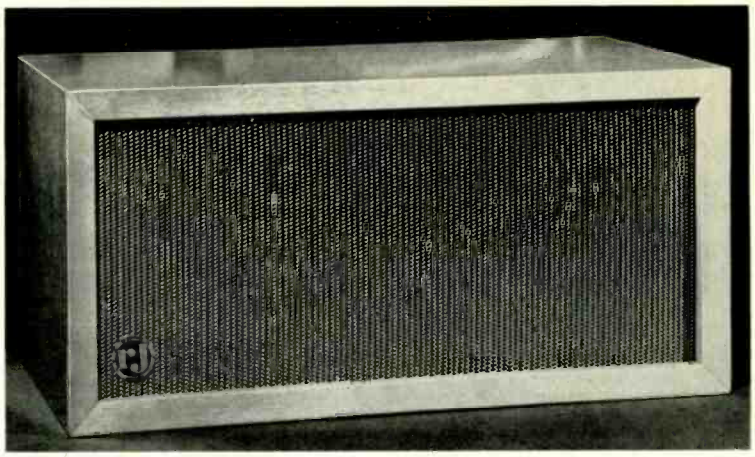


Fig. 2. The R-J "Wharfedale" Speaker.

The R-J principle consists of mounting the loudspeaker on a baffle spaced a small distance back of the frontal board, the latter having an especially shaped opening directly in front of the cone. The speaker-mounting panel is so placed that there is an escape for the air behind the speaker through openings whose acoustic resistance is controlled. The frontal opening and the enclosure volume are designed to resonate at a frequency somewhat lower than the free air resonance of the cone, thus increasing the acoustic output at the lower end of the spectrum. The acoustic resistance of the escape passage damps the resonant peak and smooths the response throughout the lower range.

Under test, this speaker showed no rattle or cabinet vibration anywhere in the audio spectrum, even at a steady two-watt input —which provides an acoustic level of over 90 db in an average size room. In direct comparison with a 8.25 cu. ft. three-way corner speaker system, somewhat less bass response was noted. On direct listening, however, over-all response is considered excellent.

In another test, two of these units were set up in a small suburban night club for the reproduction of records. The speakers were spaced about 20 feet apart, and operated at less than ½ watt program level. This arrangement gave a pseudo-stereophonic effect, the sound appearing to come from a point about halfway between the two units. This observer—along with most of those in the club—came away with an increased respect for this little speaker with the big sound.

BROCINER UL-1 AMPLIFIER, CA-2 CONTROL UNIT, A-100 PREAMP

This series of units—although over a year on the market—is still well up in the running with respect to the quality of reproduction. The power amplifier, *Fig.* 3A, employs the Ultra-Linear circuit, and achieves a power output of 30 watts with only 1.05 per cent IM distortion; at 40 watts, the IM distortion is only 8 per cent. From the standpoint of power output and IM distortion, this amplifier rates as one of the best three tested so far. The preamp and control units are separate chassis, although they are often mounted together as shown in *Fig.* 3B. The A-100 Preamplifier-Equalizer provides four turnover positions, and rolloffs of 0, 4, 8, 12, 16, and 20 db at 10,000 cps. The CA-2 Control Amplifier incorporates a selector switch for four inputs, a volume control combined with the power switch, and step-type bass and treble tone controls. The preamplifier unit normally obtains its plate and filament power from the control unit, but when desired, the former may be had with built-in power supply as model A100-P. The compensation circuits are identical in both models.



Fig. 3A. Brociner UL-1 Ultra-Linear Amplifier.

The power amplifier employs two KT-66's, two 12AU7's and one 5V4G. It provides a 450-volt plate supply to external input units, if desired, together with heater supply of 6.3 volts—the latter being biased 35 volts above ground as a hum-reducing expedient. The power supply is well filtered, using two chokes and a total of 64 μf of filter capacitors. Output impedances of 4, 8, and 16 ohms are available. The performance curves of the amplifier are shown in the bottom section of *Fig.* 4, and the schematic is shown in *Fig.* 5. The schematic of the control unit is shown in *Fig.* 6. The performance curves for the preamplifier are shown in the upper section of *Fig.* 4. With separately controllable low- and high-frequency equalizations, it should be remembered that any of the four low-frequency curves may be combined with any of the six high-frequency rolloffs. In addition, there is a flat position for use as a microphone amplifier which may be used with any of the rolloffs—an advantage on some occasions to control feedback when the microphone is used in an auditorium.

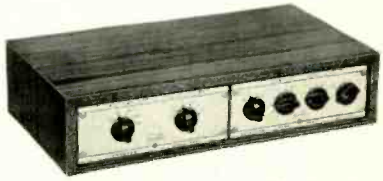


Fig. 3B. Brociner A-100 Preamplifier-Equalizer (left) and CA-2 Control Amplifier.

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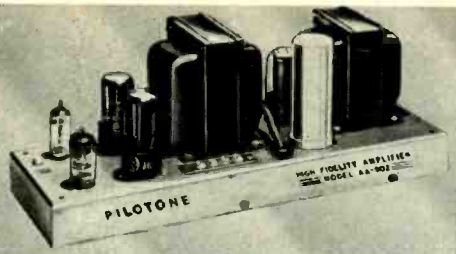
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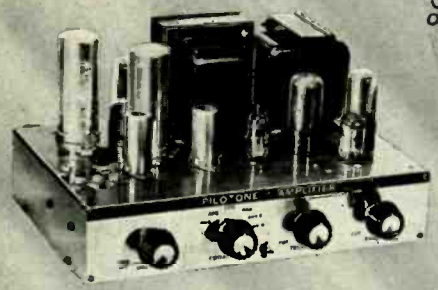
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Unsurpassed Williamson type high fidelity audio amplifier with push-pull 5881's for full 15 watt output combined with professional preamplifier for maximum efficiency and flexibility in most convenient space saving format. Six tubes plus Rectifier.

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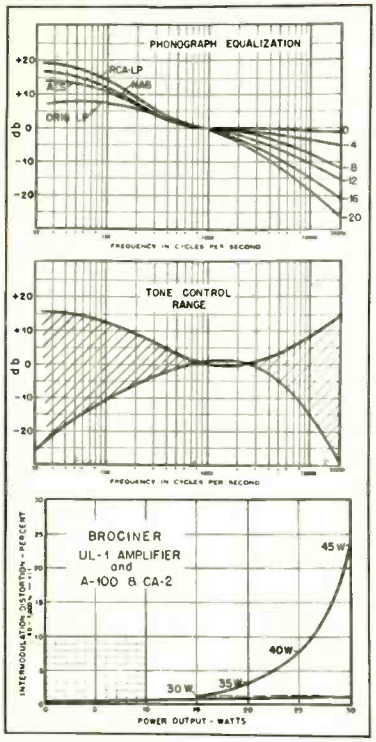


Fig. 4. Performance curves for the Brociner amplifier, preamplifier, and control unit.

An inspection of these curves shows that they cover most of the record equalization curves now in use—the RIAA curve being most nearly approximated by the RCA-LP low-frequency curve and the – 12 high-frequency curve.

The curves for the tone controls on the Control Amplifier are shown in the center section of *Fig.* 4. These are somewhat misleading because of the fact that the controls are actually step switches, while the limits or maximum curves are shown. A total of eight positions is provided on each of the controls, which gives sufficient flexibility for the most critical use, and still permits the user to duplicate settings more readily than is possible with continuous-type controls.

At the auxiliary inputs, of which three are available, the control unit and power amplifier are flat within ±0.5 db from 20 to 20,000 cps at the flat settings of the controls. A signal input of 0.28 volts is required at the auxiliary inputs to provide a 1-watt output from the power amplifier. The power amplifier alone requires an input of 0.47 volts to give an output of 1 watt.

An input signal of .002 volts is required at the phono input jack to give the same 1-watt output from the power amplifier, and a signal of only .00003 volts will give a 1-watt output from the microphone jack —sufficient gain to work with a low-impedance broadcast-type microphone.

In listening tests, the operation of the amplifier was considered smooth, free from pops when switching equalization or from input to input. This is an important point when using the presently popular super-high-frequency units, since the pops or switching clicks are composed largely of high-frequency transients which can permanently damage the delicate voice-coil suspensions of these units.

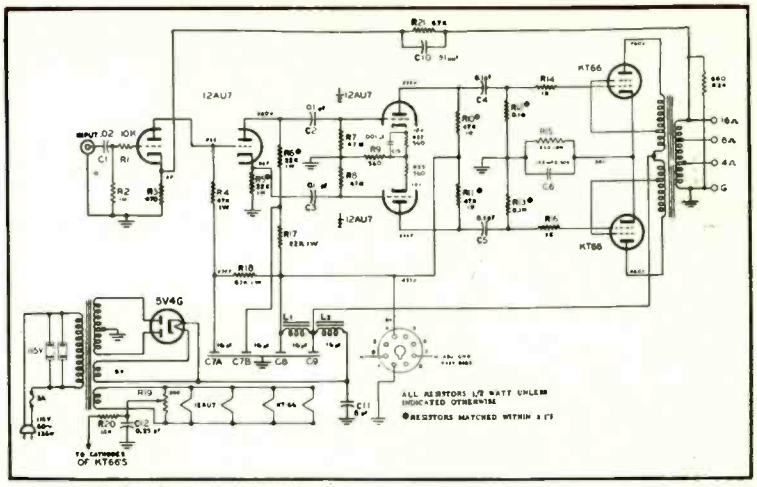


Fig. 5. Schematic of the UL-1 power amplifier.

A hum-adjusting potentiometer is provided on the control amplifier chassis. This is a potentiometer across the heater leads to allow adjustment for minimum hum. The heaters are biased approximately 133 volts above ground, and the control range of the hum adjusting potentiometer is greater than 10 db from optimum position to the poorest.

A tape recorder output is provided ahead of the volume control—providing a signal of approximately 2 volts for normal inputs. The control amplifier power supply employs selenium rectifiers, and is well filtered. A power receptacle is available for plugging in the power amplifier, and on its chassis two more outlets are available for phonograph motors, tape recorder, or other accessories.

The input circuit of the preamplifier-equalizer unit is somewhat out of the ordinary in that it provides for both constant velocity and constant amplitude pickups. All magnetics fall in the first class while the Weathers capacitance pickup and crystal and ceramic units are of the second type. The circuit provides proper termination for all current types of magnetic pickups.

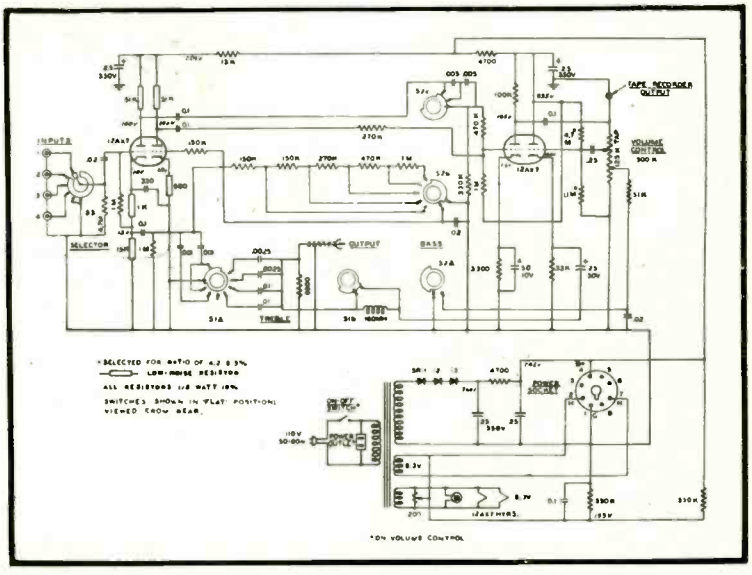


Fig. 6. Schematic of the CA-2 control amplifier.

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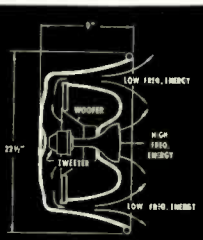
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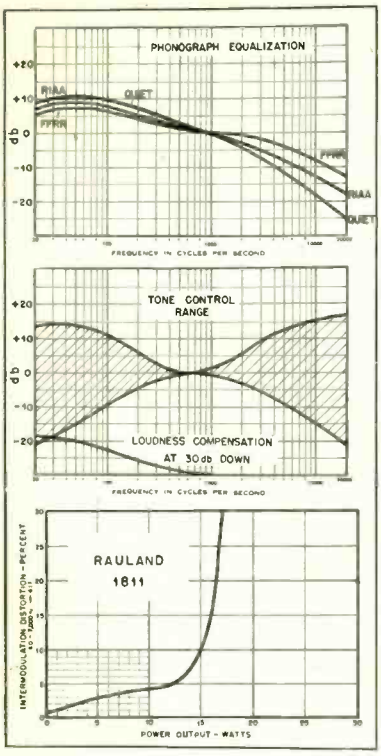


Fig. 7. Performance curves for the Rauland 1811 Amplifier.

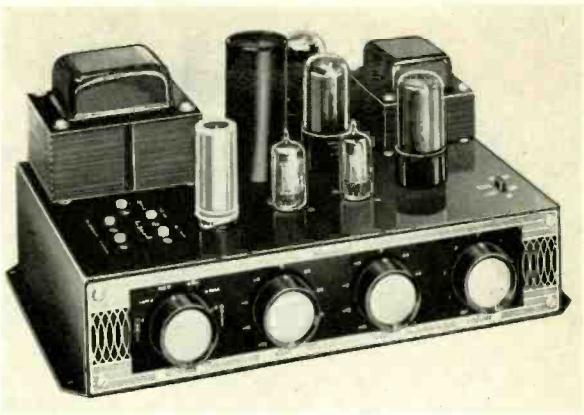


Fig. 8. Rauland Model 1811 Amplifier.

RAULAND 1811 AMPLIFIER

The continuing interest in high fidelity music reproduction in the home has resulted in some excellent amplifiers at prices low enough for anyone. Fortunately for the buyers, simplification in amplifier construction has been the natural outcome of the reduction of the number of recording curves in actual use, and this has been followed by lower costs. And for all but the old-timer who has been collecting records for ten years or more, as few as three equalization curves are sufficient.

The Rauland 1811 amplifier provides all the flexibility necessary to the average hi-fi enthusiast in a compact single-chassis unit that is easily installed. It consists of only six tubes, including the rectifier. The first tube, a 12AX7, is a fairly conventional preamplifier with feedback around the second half of the tube to provide the equalization. The first half of the second 12AX7 serves as a cathode follower to drive the tone-control circuit; the second half is a voltage amplifier. The third 12AX7 is arranged as a voltage amplifier and a cathode-follower type of phase splitter. The fourth and fifth tubes, 6V6's, are the output stage; the sixth is the rectifier.

Two phono inputs are provided—one with 27,000-ohm termination for Pickering pickups, and the other with 49,000-ohm termination for Audak, G.E., and the Fairchild transfomer. A microphone input is also provided, the input impedance being 1 megohm at this Jack. Low-gain inputs are provided for radio tuner and for the output of a tape recorder or other high-gain signal source. *Figure* 8 shows the appearance of the unit, with its gold embrossed control panel.

Performance curves for the amplifier are shown in *Fig.* 7. IM distortion is about normal for 6V6 amplifiers, and the range of the tone controls is conventional, as will be observed by comparison with other response curves.

Equalization curves for the phonograph input are slightly more gentle than most current amplifier models, and some use of the low-frequency tone control is required to provide exact equalization for modern records. However, with such additional bass boost, the correction is completely satisfactory. Loudness compensation is switched in or out of the circuit, the switch being located on top of the chassis. This is a desirable feature since it would discourage continual changing of the setting which is likely to become annoying to one who expects to find the same response every time he turns the amplifier on.

A study of the schematic, *Fig.* 9, shows that the heater supply for the preamplifier stage is 10.4 volts, feeding the 12.6-volt connection of the filaments. Note also that the hum balancing potentiometer is across only this one winding, and that it is biased 23 volts above ground, being connected to the cathodes of the output 6V6's. The lower voltage on the preamplifier stage results in less tube noise in addition to lower susceptibility to hum disturbances.

Signal inputs of 0.15 volts are required at the tuner and tape jacks to provide a 1-watt output with the volume control at maximum and the tone controls set for flat response. This indicates that if any of the newer types of ceramic pickups were plugged into the tape jack there would be sufficient gain to give adequate output for any application. At the magnetic phono input jacks, a signal of .008 volts is required for an output of 1 watt, and at the microphone jack the signal required for the 1-watt output is .011 volts—easily supplied by any of the high-impedance microphones commonly available. Bass and Treble controls are of the continuous type, with the escutcheon marked with approximate calibrations from −16 to +16, which corresponds closely to the response at 50 and 10,000 cps. Available output impedances are 8 and 16 ohms. Power consumption at the standard 1-watt output was measured at 45 watts.

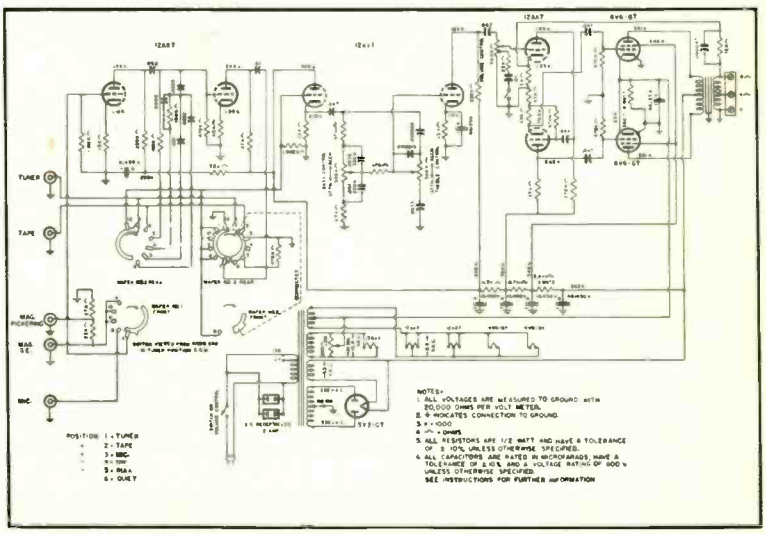


Fig. 9. Over-all schematic for the Rauland 1811 Amplifier.

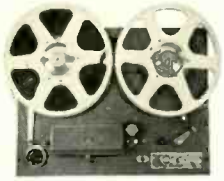
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What's your choice in fine tape equipment?



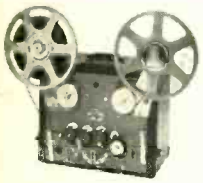
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Precision tape amplifier for portable use or rack mounting. Composed of individual record and reproduce (monitor) amplifiers on a common chassis; separate power supply; three-microphone input, 250 ohm low level mixer; illuminated V.U. meter. Output of reproduce amplifier, 500 ohms, plus 20 db maximum. May be used with any model PRESTO tape recorder.



PRESTO TL-10

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Edward Tatnall Canby

The Composing Machine

HAROLD LAWRENCE'S excellent account in our September issue of the possibility that the musical performer may be by-passed in favor of direct, composer-to-consumer music goads me into expressing some strong but possibly unfocussed feelings on the subject. I can only say, to put said feelings in a few words, that there's something wrong—somewhere. Not with the Lawrence report, which is decidedly an authorative and informative round-up of the situation; but rather with the whole idea itself. It rubs me the wrong way. And that in spite of my perfectly rational ability to see the arguments—which are very, very strong ones. Yes, electronic direct-composed music (like a direct-coupled amplifier!) is a very logical development from just about every point of view.

What is music? That, I guess, is what is really eating me. Not a question to worry most people, however different their tastes. Music is something you like. Or maybe it's something you dislike. (A decade or so ago the big argument was whether "real music" was classical, or jazz and folksong; that sort of bickering is pretty dead right now. Everybody knows that the best of all the "classical" music, from many different times and places, and the best of jazz and folk song, are all decidedly "real" music.

Paper Music?

Music, first of all, is undeniably actual sound, transient wave-forms. "Paper" music is vitally important because it is—or has been—the abstract and universal record of music itself, not a single performance but a special form of theoretical music over and above all actual performance. But, in the end, the music lives and dies by the test of its sound. It *is* sound.

Paper music, in my dictionary, is in the same category as paper amplifier. It may be a pretty amplifier circuit to look at; its electrical theory may be dazzlingly beautiful to those who can understand. (Here, after all, is the glory of pure mathematics, which divorces itself as far as it may from practical applications.) But an amplifier realizes itself, however imperfectly, in but one way, in the practical form of wires and solder, tubes and transistors, a solid, three-dimensional instrument with a purpose.

Why argue on this point? Because paper music has always had a fascination for those who can "see" it, and paper music is a widespread preoccupation of composers today. One learns much of the abstractly beautiful and impossibly perfect inner workings of a symphony from the sight of its score during the playing. Similarly, the electronics man can study the circuit diagram of a realized amplifier in front of him and the two are separate entities—one an idea, the other a given practical realization, probably imperfect. Expert musicians can create inner mental musical sound direct from an unknown score, never before heard. Not even all composers can do that, unfailingly. They often guess wrong.

The tendency today is towards appallingly complex music. The psychological battle has produced much "self-defense" music that is almost deliberately hard to understand for the uninitiated and hard to play as well. The difficulty in realizing performance has driven many a composer to write "sour grapes" stuff, clique-music, that is less, not more, adaptable to outward realization. This will be hotly denied, without exception, by all concerned, of course. I think it is the truth nevertheless, even though the ultimate quality of the music may even be extremely high. "Good" music is by no means always simple, universal music. Good music may be self-conscious, embittered, clique-ish, of limited appeal, and still good. It often has been. It can also stink and be of "wide" appeal. I'm not, at the moment, speaking of musical worth, but merely of the tendency towards musical theoretics, on paper.

The highly mathematical twelve-tone music (all music is mathematical, even the most emotionally expressive . . .) leads the tendency today towards paper music. Twelve-tone composers work to get their music played, of course; but, sound or no sound, there is for me a certain sense, conveyed both by the music itself and by the descriptions of it, the shape and cast of its surrounding theorizing, that here is "beautiful-circuit" music.

It may be realizable in sound—but it definitely exists on paper, this twelve-tone music. The need for a score to look at while listening (or hearing it inside the head) seems often very, very important.

Proxy Pitches

A tendency only, not a rule. I am sure that (a) the really good twelve-tone composers and those who adapt part of the theory will in the end prove to be *sound* musicians, even if the lesser lights lose themselves in paper formulas; and (b) I

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PILOT AF-860 FM-AM TUNER:



Incorporates Armstrong dual cascade limiter on FM, sensitivity better than 1.5 mv for 20 db quieting, continuously variable AFC. AM features broad or sharp tuning. Other features include slide rule dials with logging scale. Cathode follower output permits use of interconnecting leads up to 100 feet for remote operation of amplifier without loss of fidelity. Built-in pre-amplifier contains 5 positions of treble roll-off and bass turnover. Precise loading of magnetic cartridges available by means of calibrated potentiometer. Self-contained and fully enclosed front panel assembly. Gold and maroon front escutcheon. Power requirements: 117 volts, 60 cycles, 65 watts.

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WEATHERS "DEBONAIRE" K-700 RECORD SYSTEM:



Weathers FM pick-up system and manual turntable COMPLETELY ASSEMBLED ready to plug into existing audio system (with either pre-amp or flat amplifier). Includes Weathers FM cartridge with sapphire stylus; standard tone arm for 12" records; combination pre-amp, oscillator and power supply; turntable with cushioned record float; blonde or mahogany finish Formica case. Pre-amp has volume, bass and treble controls, continuously variable turnover frequencies from 200 to 1000 cycles and selector switch. Smooth satin-finish turntable never touches record playing surface. Dust from turntable can't injure record grooves. Record rides on cushioned float the size of record label.

NET **$124.50**

PILOT AA-410 BASIC AMPLIFIER:



A 15-watt amplifier that is completely adaptable to any high fidelity system. Compact chassis size affords easy mounting in minimum space. The ideal basic power amplifier for remote control installations or for coupling to a tuner-pre-amplifier combination. Heavy gauge steel chassis finished in brushed gold and all transformers are potted for long life; are impervious to atmospheric conditions. SPECIFICATIONS—Power output: 15 watts; frequency response: ±1 db 15-40,000 cps; distortion: less than 2% at rated output; nose level: 90 db below; output impedance: 4, 8, 16 ohms; power requirements: 117 volts, 60 cycles, 100 watts; size: 12⅜" x 4¼" x 6⅛"; shipping weight: 16 lbs.

NET **$49.50**

WEATHERS M-120 TONE ARM AND PRE-AMPLIFIER COMBINATION





Tone arm, FM pick-up cartridge with sapphire stylus, combination pre-amplifier, oscillator and power supply with connectors; in blonde or mahogany finish. Pre-amp has volume, bass and treble controls and continuously variable turnover frequencies from 200 to 1000 cycles. M-120 with Standard Arm for 12" records and with cabinet. Be sure to specify blonde or mahogany finish.

NET **$83.75**

Note: Arms available in blonde or ebony finish. Be sure to specify arm color.

PILOT AA-420 CONTROLLED AMPLIFIER:



A beautiful amplifier housed in a gold and maroon crackle case. Use wherever convenience dictates without installing any special furniture. Dual equalization switches provide 5 positions of treble rolloff and 5 positions of bass turnover for precise matching of all equalization characteristics. Loudness control may be set constant by means of individual level settings on each input. The phono pre-amplifier input is available for precise loading of all magnetic or available reluctance cartridges by a calibrated potentiometer. SPECIFICATIONS—Output: 20 watts; frequency response: ±1 db, 15-40,000 cps; speaker impedances: 4, 8, and 16 ohm; power requirements: 117 volts, 60 cycles, 110 watts; size: 13" x 10" x 5"; shipping weight: 21 lbs.

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am sure that the enormously influential twelve-tone principle is basically a good and useful one, as the ultimate extension of that intellectual refinement, the equally-tempered scale.

Twelve tone music, as I understand it, depends wholly on this arbitrary division of pitch into equal intervals that was made up by man, that does not exist in nature. So, too, does most music of the last couple of centuries. Don't think that arbitrary "unnatural" pitch is any deterrent to musical expression. But there is a difference: heretofore, a good deal—not all—of the musical sense of tempered-pitch music has been by *implied* meaning, tones that actually should be higher or lower than the fixed tempered ones. Tempered tones are taken by the ear as pitch-proxies—a G-sharp is actually higher than an A-flat though the tempered tone that stands for them is the same.

Twelve-tone music, on the other hand, makes these tones into absolutes, with no implications of any sort in their relationship to other tones except that of the arbitrary order in which they are set up, the "tone row." Thus here we have the ultimate use of the tempered-scale intellectual system.

Contrived music—yes. Artificial, intellectual, arbitrarily mathematical. But paper music—not necessarily. Twelve-tone musical reasoning, or musical expression (which is the same thing, if it is *good* musical reasoning) is definitely accessible to the ear, and should always be. And this in spite of the composers who take refuge in mathematical eye-music.

(Nobody said music has to be for the ear alone—except that generally speaking that is what we mean by music. If somebody sets up a new kind of expression that deals in eye-patterns, then the word "music" simply cannot apply, by accepted definition. Get a new word.)

Unwritten Music

But, back to *la musique concrète,* the direct-coupled, composer-to-listener stuff. In the first place, it will be seen that here is the antithesis of the other great tendency today—the above-discussed paper music! Here is music that has no paper intermediate stage, or will have none if its promotors have their way. No more, at least, than the equivalent of an artist's rough sketches, "cartoons," which are not the final work at all but merely steps in its direction. There is a vast precedent for unwritten music. All music was that way, until comparatively recently in the West. All genuine folk music, by definition, is still that way. No written work. Purely an art for the ear alone transmitted by ear via free imitation.

Direct-composed music, then, is in the oldest tradition of musical art—so far. But note the divergency. Folk music is conveyed from *performer to performer,* its tradition, style, sense, continuity goes *from composer to composer*—the two being one and the same. Folk music makes sense in terms of performance, of actual human expression in action. It is "live" in exactly the sense we use for radio and TV. It is there, existing, happening; it is the audible, organized expression of a human being in action.

Classical music? More refined, for it introduces the element of interpretation. More strictly, it confines the freedom of the performer much more closely, via the printed note, though he is still blessed with a great deal more freedom than most of us realize. Mere notes, without an aural, *heard* tradition to back them up, are singularly useless and insufficient.

My own feeling is that classical music is basically a refinement of folk music—of the basic musical art itself. Yes, we have proxies now who do the composer's expressing for him, according to rough written instructions. Very rough, when you come down to it. We have a fine local tradition that says (a) YOU MUST STICK TO THE WRITTEN NOTES and (b) YOU MUST INTERPRET THE WRITTEN NOTES—PREFERABLY IN YOUR OWN UNIQUE WAY, a basic contradiction that never seems to bother us. But the fact is that music—all music—is invariably the expression of a human being in action.

All music is action. All music, too, is ordered, organized action. It expresses via a language, many-formed, but making ordered sense to the listening ear if it is any good. (And don't think that "order" and "emotion" are opposites, that mathematical music is dry and uninhibited "free" music is the most expressive! Is inarticulate howling more expressive than anguished speech? It takes content and sense in any language to convey human emotional expression beyond the most primitive grunting.)

The Musical Tool

Now granted that in our fine musical system we have developed the proxy idea to a high degree. The composer now practically never does his own direct sound-expressing. Somebody, or a whole lot of people, will always do it for him. We must grant another very important aspect of today's refined music, too. It is based very largely on the Musical Tool. Instruments are proxy voices, or proxy fists and heels for raining blows or hurling stones and sharp things with cutting edges.

The musical tool is as simple as the agricultural tool. It is wonderfully effective. A man can yell his angry insults from the front window of his car, but he can do a much better job with that one-track, one-note expressive sound-tool, his horn. How extraordinarily expressive horn-language is! What a variety of things you can say, via the simple beep, or the rampaging, temper-losing blast. That is a musical (to a certain extent) audible proxy instrument. A piano, a violin, a trombone, can do the same in a fancier and more subtle way. Also somewhat more civilized.

Can we have music without human expression? Can music be a mere pattern-in-sound, objective, inexpressive, just existing? Not for my ear. Nobody thinks much of that sort of thing any more in the other arts. Mr. Freud and others, indeed, have filled inanimate, insensate shapes and abstractions with so much human expression that an inexpressive, pure-pattern art object is just about inconceivable to us. Unless, of course, it simply says nothing, expresses a meaningless confusion. In which case it is hardly art. It doesn't even have an intelligible existence.

So, finally, we can look, rather briefly, at the direct-coupled composer-to-composer electronic music and see what it *must* have, what could be missing, and in all likelihood will be missing in many cases. It's a fad, remember, and fads attract the dopes and the fools as well as the wise who find the true possibilities in all the foolishness.

Musique concrète, music composed by machine, whatever its method, whatever its shape, must be, first of all *expressive,* humanly expressive. It cannot exist as a mere objective mixture of sounds, patterned or no. Not in my book, anyhow. Music *is* human expression.

Second, it must be *ordered and sensible.* That is a very, very wide generalization, for order, continuity, sense, design, can come in a million ways, even within the world of sound. It is, of course, the search for new kinds of order that leads composers to try out such incredible ways of disorder as that famous concerto for twelve haphazardly tuned radios. Haphazard as to the specific sound—but not at all haphazard as to the time element, the rhythm pattern. At least, this was the intention. It didn't work very well but the idea was potentially sound. Remember that most early classical music was written down without special instruments indicated—or even any distinction made, often, between voices and instruments. "Apt for Voices or Viols" said the Elizabethans of some of their music, i.e., its basic sense, its expression, could be carried out and realized in a great variety of different sound-mediums. The twelve radios were an extension of this principle—perhaps to an absurdity, but then all experimenters carry things to extremes, just to see what the implications are. A very sound experimental principle as every engineer knows.

All of which, you see, leaves our composing machine music in the clear and quite legal. It can compose with form and shape, of course; it can be as expressive of a human-being-composer as is a played piano piece, though the proxy is now more detached; there is no human proxy, though there is the musical tool, the electronic sound medium. Far-fetched, yes. A tenuous line of human communication, yes. A composer who mixes up sound effects and sends them out for you to hear is not close to you, (in a human sense) but very far away. He has a vast bridge to build, a gulf to cross, if he is to convey human expression to you via his sound. But he could do it. He can do it.

What, then, is wrong? What is wrong with the composing-machine music that has so far emerged, or has been talked about? Very simple. *It isn't music—yet. It is merely a musical tool, under development.*

It hasn't said anything. Not to my ears, so far. It can, but it hasn't. Instead, it has merely asserted its existence, which we cannot deny, and its rightfulness as a tool, which we cannot deny.

What About Music?

You see, the problem, oddly enough, is a purely musical one. What shall we compose with this new kind of direct-coupled musical tool?

That, I'm sorry to say, nobody is talking much about. With all the fuss and feathers over taped music, not a composer, not even

(*Continued on page 70*)

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BASIC SYSTEM—MODEL S-300

Uses

The Model S-300 is a complete loudspeaker system with low distortion, wide angle of distribution, extraordinary frequency range, and specifically designed for home or auditorium use.

For applications that permit the mechanism to be mounted in a true infinite baffle or in a suitable enclosure of 50 cubic feet or more, the system may be used with assurance that the entire frequency range will be realized. The speaker's outstanding performance, when suitably baffled, makes it ideal for the reproduction of organ and concert music, in the home and auditorium.

The basic system, Model S-300, comprises two sets of speaker mechanisms. The first is a single voice coil driving the Styrocone speaker which reproduces the bass and middle range to about 3000 cycles. The second is an array of 4 direct radiation tweeters oriented to give wide dispersion of the high frequencies. This second unit of the system is connected through a condenser which provides a smooth transition without incurring poor transient response.

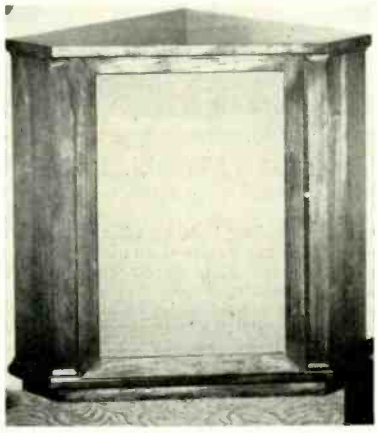
The Styrocone speaker is distinguished by the large acoustic radiation surface it provides for adequate clean bass response. The radiating surface is a 20 in. diam. cone thus providing 300 square inches of vibrating surface at the low frequencies where piston action is the mode of vibration. This is equivalent to four 12 inch woofers or two 15 inch woofers.

SPECIFICATIONS
MODEL S-300
LOUDSPEAKER SYSTEM
COMPLETE SYSTEM

Impedance	8 Ohms
Frequency response	16-15,000 cps
Power Handling Capacity	25 Watts RMS 50 Peak
Weight unpacked	30 lbs.
Dimensions	24" x 34"

STYROCONE UNIT—MODEL 300

Radiating surface	20" diam. Cone Piston
Frequency response	16-3,000 cps
Power Handling Capacity	25 Watts RMS 50 Peak
Voice Coil	1½" diam.
Magnet	1½ lb. Alnico V.
Resonant frequency	Below 20 cps
Dimensions	24" x 24"



Symphony
MODELS SW-300 & SC-300
COMPLETE SYSTEMS

These comprise the Model S-300 mounted in cabinets for use against the wall and for corner location respectively. Either enclosure is a completely enclosed heavily damped cabinet and the performance of the speaker system is independent of location except as the sound is effected by the listener's environment and is available in walnut, blond or mahogany finish.

Height	38"
Width	41"
Depth (Model SW)	15"
Depth (Model SC) illustrated	26"
Internal capacity	8 cu. ft.

Frequency response is essentially flat from 35 cps to beyond 13,000 cps.

Majestic
MODEL SA-300

This unit comprises the Model S-300 in large cabinet designed to achieve range of response substantially equal to that obtained with the Model 300 Styrocone Unit when it is mounted in a rigid infinite plane baffle.

Each cabinet is made of heavy veneer and is available in either mahogany or blond finish.

Height	60¾"
Width	35½"
Depth	20¾"
Internal capacity	20 cu. ft.

Frequency response is essentially flat from 25 cps to beyond 13,000 cps.

BASIC SYSTEM—MODEL S-225

Uses

The Model S-225 is essentially the same as Model S-300 except that the styrocone unit is smaller and two instead of four tweeters are provided. Substantially the same range of authentic bass reproduction is achieved in a smaller enclosure at less cost and space requirement than the larger unit.

SPECIFICATIONS
MODEL S-225
LOUDSPEAKER SYSTEM
COMPLETE SYSTEMS

Impedance	8 Ohms
Frequency response	20-15,000 cps
Power Handling Capacity	20 Watts RMS 40 Peak
Weight unpacked	25 lbs.
Dimensions	34⅛" x 20⅜"

STYROCONE UNIT—MODEL 225

Radiating surface	17" diam. cone piston
Frequency response	20-3,000 cps
Power Handling Capacity	20 Watts RMS 40 Peak
Voice coil	1½" diam.
Magnet	1½ lb. Alnico
Resonant frequency	About 20 cps
Dimensions	20" x 20"

Concert
MODEL S-225 VH

This unit comprises the Model S-225 in sturdy heavily damped cabinet that may be used either with the long dimension vertical or horizontal. Legs are provided for installation by dealer or customer to accommodate either application.

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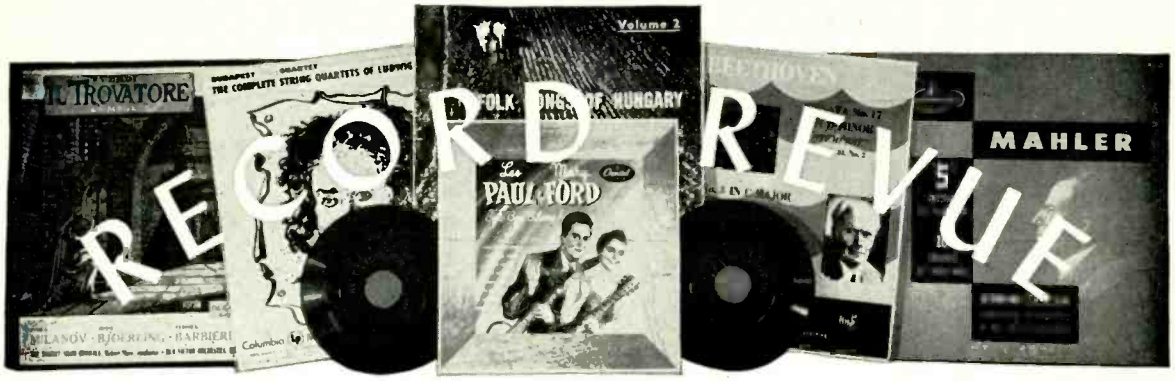
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EDWARD TATNALL CANBY*

A COUPLE OF TAPES

SOONER OR LATER, if what we are told is true, every record reviewer will be a (pre)recorded tape reviewer as well as a disc judger. Theoretically we have, already, two types of "records." But that time is not yet here in practice in spite of the new tape releases. For one thing, it hasn't yet occurred to the tape proponents to send out tape review copies on a regular basis, as is done in the disc field. Our tape coverage, it seems, will have to be sporadic for awhile longer until the tape people get organized, with regular periodic new releases. (RCA Victor's tapes, for example, aren't even available for review except on loan—"too expensive." I've been on a waiting list as long as I can remember.)

Evidently most of the present tape offerings, consciously or not, are in the nature of trial balloons; serious thinking as to what permanent musical niche each line of tapes will take has not yet become evident. There's no clear distinction between tapes that are duplicates of available discs (and thus necessarily a "de luxe," high-quality version) and other tapes which are unique, "originals" without disc equivalents. There is a strong current of doubt as to whether tape music should feature the usual "name" artists or should be anonymously offered; that is, whether it is background stuff, or foreground. It's not at all clear which of the tape advantages are important in each case—hi-fi quality, long wear, background-play, and so on. All of which is inevitable in a new field, still not at all clearly defined, in anybody's mind. We can't all be unerring good-guessers. Time will tell.

Yet with all of this taken for granted, the seeds of trouble are aleardy sprouting, as suggested in AUDIO ETC in the August issue. Steps are being taken towards agreement on recording and playback tape curves —but not in time to clear up present inconsistencies. Take the following two tapes as illustrations for the current situation.

Dittersdorf: Quartet in E Flat. Turina: Prayer of the Toreador. Wolf: Italian Serenade. Fine Arts Quartet.
Webcor 2922-3 (5" 7½H)*

A pot-pourri of this sort sets LP fans howling with rage, but let that pass for the moment. The music is beautifully played and is basically solid stuff, if slightly on the connoisseur side. (One wonders whether Webcor took whatever the Fine Arts group happened to have around! Dittersdorf is not exactly a composer well known to non-specialists.) But look at what is at this point more important—the tape itself.

First let me state a principle. *A good tape, technically, is one that sounds best on good equipment. A good tape will not compromise for the weaknesses of lesser equipment in any manner that will lower its performance value (properly equalized) on good equipment.*

In other words, the only good tape is a hi-fi tape, for anybody's player. Why bother to argue this point? Because, though it has long since been conclusively settled in the disc field—a good disc is a hi-fi disc—there evidently is a lot of doubt in the tape area. The problem is of course tied up with that of equalization, as it was in disc records. But equalization is only part of the story. We have had many low-quality discs, for cheap players, and awhile back there were those who deliberately claimed that what was best for professional disc playing equipment was not best for home machines. Not any more! Now, "Hi-fi is for everybody"—and for all disc players. I agree. But tape? The same *must* apply. There can be but one standard of tape reproduction—the best, as achieved on the best equipment. Whatever equalization "compromise" is worked out in the end, the over-all results will have to be *first of all* hi-fi on expensive equipment, secondly, as hi-fi as is reasonably possible on cheaper equipment. That is the way it is done in discs, and the way it must be done on tape.

For this reason I've borrowed an Ampex double-track 600 to make initial listening tests on the first new tapes. It represents as near to a high-quality standard for playback as we are likely ever to have in convenient portable home form, and the Ampex playback curve is the most likely bet as a basis for the hoped-for agreement among tape record makers and tape recorder makers. And so—back to Webcor.

First, the Webcor tape (one of a series) is entirely presentable for musical listening; it has, moreover, that unique silence in the background and lack of metallic "ring" in the foreground, characteristic of tape. Good.

But I found at once that for tonal balance comparable to that of several disc records of string quartet music I had on hand I was forced to boost the high end considerably, on my amplifier controls. The low end seemed too heavy, also, though the slight bass of a string quartet made that element harder to judge. In other words, this tape is *not* equalized for playing on machines having Ampex-type playback curves (the equalization done in the recording) which include, if I am right, the Revere and Crestwood lines. I deduce that the Webcor tapes will play nicely on Webcor machines without tonal alteration.

OK—so Webcor uses one curve and Ampex another. Disagreement, reflecting a division that runs right through the tape industry right now. But beyond this, I found that the Webcor sound was strictly so-so as to cleanness and general recorded quality. Almost any disc I can think of is superior in crispness and clarity, by direct comparison. Moreover, the recorded level, as registered on the fixed-level Ampex VU meter, was very high, the needle remaining at the pin for most of the louder passages; the recorded sound confirmed this, with frequent overload distortion at the dynamic climaxes, as far as my ear could tell.

Now let's get this straight as well as possible. Several inquiries to Webcor as to what recording curve was being used (and what playback curve would match it) elicited only the information that "the NARTB curve is the accepted one for professional tape recordings by radio broadcasters." Fine, but as I get it, NARTB merely states that the *sum of the recording and playback curves* is to be flat within so-and-so tolerances. Now any tape recorder can do that, inside itself—but what about differing curves? Ampex plays its own tapes back flat (NARTB) and so does Magnecorder and Webcor and many another—but what happens when the tapes are played intermixed?

Webcor states categorically on its box that "You can play this recording on a Webcor tape recorder, or any other make, providing you have a standard speed playback." (Half-track, I might add, though Webcor doesn't say so. I can play these tapes on my full-track Magnecorder at 100 per cent increase in efficiency—I hear two tracks at once). Now technically, Webcor is quite right; you can play these tapes on any machine that plays 7½ ips, half-track. *But on many machines they will not be correctly equalized.* I suggest that, according to my ear, they will not produce anything very extraordinary in the way of hi-fi sound an any machine, Webcor or otherwise.

If (pre)recorded tape is to get off on a solid foundation, I think that better things must be offered. Better quality than is evidenced in this series. And more candid facing-up to the equalization problem. Take the other tape I am now considering:

Smith: Desert Suite. From film score of "The Living Desert" (Disney). Anon. Orch., Peluso. Anon. Commentator. No cat. number.
(1 5" reel 7½H*, one track blank.)

*7½H = 7½ ips half-track. 7½S = 7½ ips, single-track.

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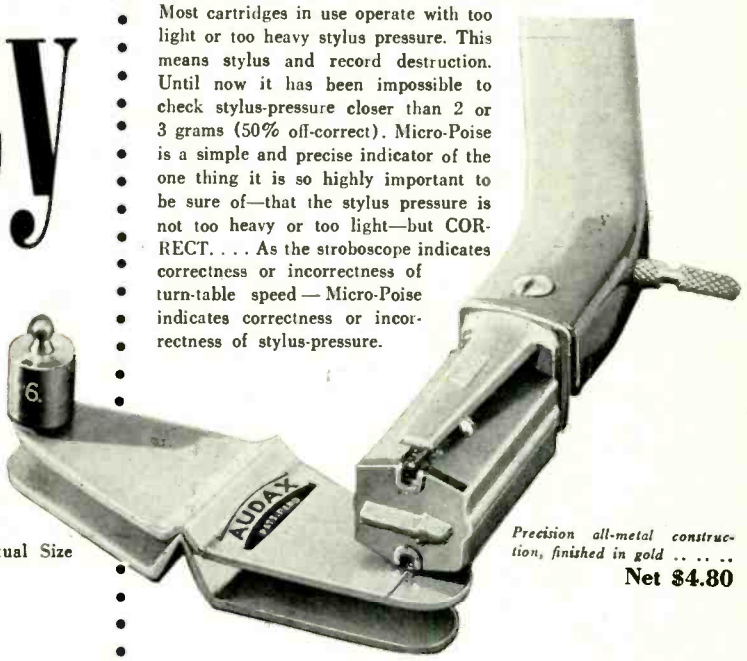
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Here, for contrast, is a wholly different story. The labeling and identification are slightly confused, as you'll note above, and the producer, Minnesota Mining, doesn't say whether the tape is single, half-track or anything about playback. (I found, by simple experiment, that it was half-track with one side unused.) The music, touted as a superb score as might be expected, is just the usual sort of competent, platitudinous film music, nice but entirely undistinguished in any permanent way. The anonymous commentator's slightly hoarse voice tells us rather solemnly what each scene is about, over the musical background. The playing time, one direction only, is short.

But the tape sound? It didn't take two seconds to guess all there is to know about this tape. Gorgeous wide-range, hi-fi sound (rather dead studio-type acoustics, film-style) at 7½ inches on the Ampex 600 and I'll bet dollars to decibels this was made on an Ampex. In any case, the equalization is instantly and obviously right—and the tonal range is obviously wide.

This, then, is the kind of tape we can hope for, technically, from all tape companies in the future. As played on top-quality equipment of industry-standard type, it gives optimum quality at the 7½ ips speed. Played on cheaper machines it may be too bright in the highs—but tone controls can roll off the upper end. On a wider-gap heads of less good quality the upper highs may be lost; poor electronics may distort what remains. *But the stuff is there, on the tape.* Good.

I gather that, among other lines, the AV Tape Library adheres to the present Ampex standard both as to the record-playback curve and the wide-range recording via the Ampex head. As mentioned above I have yet to hear an RCA tape and do not know what standards are used—but since the RCA offerings are duplicated on RCA hi-fi discs we can assume a high-quality tape sound, necessarily. When and if the new committee set up by the Magnetic Recording Industry Association arrives at an industry-wide set of record-playback curves, we can hope for high-quality sound in all (pre)recorded tape offerings. But at the moment there are two drastically different "schools" of equalization, those who equalize, as does Ampex, in the professional manner—i. e., with the high-frequency equalization mostly in recording and the low-frequency equalization mostly in playback—and those who do the job half and half, with the same amplifier curve—a cheaper way, admittedly, for budget home equipment. It may be that *two* sets of curves will have to be assumed and dual equalization positions built into playback machines. Not a simple problem at all. But at least, let's admit that the problem exists, first of all!

ORGAN

What do we want in organ recording?

1. Some of us look only for bass: we have 50-cps mental cut-offs that put aside nine tenths of the musical upper works in favor of the occasional—very occasional—rock-bottom pedal tone. But low pedal noise is singularly unimportant in organ *music*. Some day I'm going to record a special LP for the pedal connoisseurs; we'll put nothing fundamental on it higher than 100 cps and we'll play everything from Yankee Doodle to God Save the King on the 32-foot stop!

2. Others of us listen to the highs—the special organ tone-color combinations that are more and more noticeable these days what with the new "American classic" type of organ, embodying the principles of the old carefully balanced and highly colored Baroque organs. For the organ listener with a mental high-pass cut-off there is a wealth of curiously satisfying sound in the more exotic of the Baroque solo ranks, especially when the music being played is made more intelligible and alive by these contrasting tone colors.

3. Some of us—to get down to brass tacks—listen for music. We'll take anything the organ can dish out so long as it has musical interest. If we like César Franck in the orchestra or in chamber music, we'll listen to Franck on the organ and hear the same man, and recognize him. But if we hear somebody we don't like as a musician, no amount of sheer organ tone color can interest us a bit.

4. And finally, there are a few of us who are In the Profession. We listen to organ playing, organ construction, name-organists, with a highly critical ear, for we are organists ourselves, or organ builders, or organ enthusiasts. We look at organ specs on paper the way an electronics engineer looks at a paper amplifier circuit. Music (sometimes) is on a rather secondary plane . . .

The current batch of organ recordings reflects considerable confusion in these respects, as noted below. Who is supposed to be listening? Which group is the Primary Target?

Note that Aeolian-Skinner's new record features numerous organs—and anonymous players, where as Möller's record features one well known big-name organist and his own "personal" organ, made by Möller. Epic features César Franck, a slightly well known composer whose works include music for the organ.

The King of Instruments, vol. ii: Organ Literature. (Bach, Davies, Alain, Bach-Vivaldi, Langlais, Sowerby). Various organists, various organs. (Aeolian-Skinner, Boston 25, Mass. 12" LP.)

The first volume of this series (it is available through the A-S company in Boston) was a superb illustrated lecture by the dean of American organ designer-builders and A-S's chief man, G. Donald Harrison. To me it was extraordinarily revealing, as already noted in an earlier review (September).

This record is of much less precise interest. The purpose is good: to display representative organ literature of various times as played on various of the company's installations in the U. S. But the record misses fire with two groups, rather seriously. First, the semi-anonymous playing will startle organists and organ fans who want to know who provides the repast, so to speak. Second, though the chosen music is, indeed, quite representative of organ literature and organ capabilities, it is decidedly not of uniform musical interest to other than pure organists.

Thus, we begin with three of the Bach Schübler chorale-preludes, to please anybody who knows Bach; but next comes a perfectly dreadful bit of dripping organ soft-soap that hits any non-organ musical ear as a positive insult—especially when the following number is also Bach. (Sorry, but this is what my ear, and I'm sure others, will hear in Sir Henry Walford Davies' "Solemn Melody.") The modern French works that follow are, too, of a school of expression that for many of us is grotesquely unmusical. (I know that that this is a highly arguable point—but I must in all honesty record here what I know will be many musical people's quick reaction.) Another jump to a movement by Vivaldi only jars the musical ear the more, and the sweet, romantic music, semi-impressionist, of Leo Sowerby is another jolting musical contrast though for my ear it is pleasant and sincere stuff after the hard, tortured French.

All very interesting, but I am sure that the pervading sense here that this is an organist's program will limit is wider appeal very considerably. Mixed motives.

P.S. If you look very hard on the front album cover, where the various organs are located geographically and by name, and then in the program notes on the back—where they are not—you will find buried in the small type a semi-identifica-

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tion of the actual players. A few are mentioned by name—"played by Roy Perry"; a number of others merely get "played by the staff organist," a very curious kind of billing indeed—until you begin to put the back cover and the front cover together.

By dint of much turning-over and turning-back I discovered that the "staff organist" was in two cases playing upon the new organ in Symphony Hall, Boston. Now it's just conceivable that the anonymous gentleman there is actually an organist who goes by the familiar name of E. Power Biggs, one of the Biggest names in the business.

So big, in fact, that I'm willing to guess he has exclusive organ-playing contracts with Another Recording Company. (The staff organist of the First Presbyterian Church of Kilgore, Texas may or may not be the same anonymous person, or another with similar outside commitments.) And so he plays on this disc as the staff organist," a technically accurate statement, no doubt, but hardly edifying publicity for him.

Why, then, are the named organists in this recording buried in the program notes? Roy Perry, George Faxon? The answer is surely a matter of high etiquette and diplomacy. If the well-known Mr. X (Biggs) can't be put on the cover, then nobody else can, either. Precedence. Only goes to prove, in my guessing game, that Mr. X is somebody with a big name! Ah, the complications of recording.

Music for the Organ. (Elmore, Bach, Martini, Arne, Fiocco, Karg-Elert.) Ernest White, Studio Organ, St. Mary the Virgin, New York. M. P. Möller, Inc., Hagerstown, Md. (1 12" LP)

Not to be outdone, this rival organ company has entered the organ LP market with its own presentation. Note that officially and as of now, neither of these records is on general sale in record stores and both are available through the respective organ companies; but I suspect that many record stores will eventually carry them, or can order them direct for you.

Here we have a more concise package, played by one organist with one name, crystal-clear, and upon one organ which, if I am right, was built partly to this organist's own specifications. Really a much better idea, for it leads to various unities of sound, style, and content.

The Aeolian-Skinner recording technique above is of the straightforward kind, suffering occasionally, as happens in so much organ recording, from over-liveness and blurring of detail; it also is vaguely disturbing because of the change in locale and in acoustics from one item to another, throughout. But this Möller record is, of course, entirely consistent in its sound.

It is more of a "hi-fi" record, too, mainly in the high end, recorded with a close-up sound that brings out the tone color contrasts with extreme clarity, perhaps a bit exaggerated. The effect is not entirely in the mike placement. It is, if I know this player and this organ, also due in part to the sharply etched tone qualities of the organ itself and to the fairly close acoustical situation in which it is played (studio, not church). Moreover, Ernest White is a precise, somewhat didactic musician, never hard or unmusical in his playing, but at the same time very rarely given to lush or romantic registrations and even less to lush, romantic playing. He plays crisply and cleanly, his registrations, in every style, are on the highly colored side, with bold and often startling solo effects.

Musically the selections here, while clearly designed as in the other record to highlight organ history, are decidedly of more general musical interest and easier to take. For one thing, they are shorter. They are also more "classic," with nice minor-composer representation of the middle-to-late 18th century. Only the Karg-Elert—he is one of those eternal organist's composers—is pretty heavy going. Even there, Mr. White's exciting registrations, his bold, clear playing, make the sound palatable for non-organist hi-fi and music loving ears. A good record.

Franck: Chorals #1, #2, #3; Pièce Héroique. Feike Asma, Organ of the Old Church, Amsterdam. **Epic LC 3051**

Take this as representative of the more usual organ recording—intended primarily as a musical release of general interest. The composer is featured first, ahead of the organ, the organist, the recording itself.

The Franck works aren't easy to take for most musical ears, though patience—they are awfully

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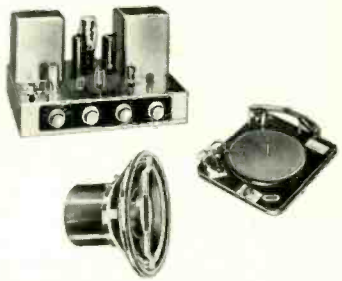


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long and very windy—will bring out the essentially honest and sincere qualities and the really beautiful melody and counterpoint. The stuff is high French Romantic, which means, of course, an almost super-Wagnerian immensity of canvas, plus an introverted, mystical religious fervor that leads to great, noisy climaxes of roaring sound, minutes long, after long, mysterious soft passages that require the utmost attention if they are to "get over." "Franckly," I find one of these immense works about all I can take at a time. Franck didn't intend it otherwise, after all.

Rather distant mike pickup, with a typical big-church blur, stylistically quite correct but, even so, pretty hard on the inexperienced ear. (An extreme contrast with the Möller-White record, above.) The vast dynamic range and extensive cathedral-like full-organ passages require, paradoxically, a rather low recording level; the extreme lengths of the works included on this one disc also require tight grooving and low level; the inner grooves (loud, as always in Romantic music near the end!) suffer from some distortion, variably according to your equipment.

Not a hi-fi collector's record, nor for the general-interest music-lovers, but those who like the music will find this an excellently conceived and very musical interpretation.

MUSIC APPRECIATION—Plus and Minus

A development that has long been "in the cards"—like the spread of hi-fi equipment and wide-range recording to a large public—is the recorded musical analysis, with lecture or commentary and musical illustration. To be specific, though in the past there have been "music appreciation" records of the old 78-r.p.m. sort, it was the LP record that in 1948 opened up vast new possibilities for music analysis in recorded form. The LP, indeed, opened so many new possibilities that we are still not caught up with them almost seven years later.

With the half-hour uninterrupted LP side and with tape recording and editing—what wonders could be done in musical discussion! Yet, for a long while, nothing was done at all. Takes time, evidently, to see these things as commercially feasible. I've been doing this sort of musical commentary on the air, illustrated with recorded excerpts, ever since 1943, but not until this year has there been any significant development upon disc records. Now—music appreciation is busting out all over. And it's pretty tame stuff, most of it. Just the old fashioned, shopworn, outdated "easy shortcuts to music" we've had thrown at us these fifty years, transferred to the new medium.

Not even the repertory has changed, and this shocks me really deeply; for it simply is not true that prevailing taste today insists upon the same dozen or so "music appreciation" war horses that were popular in 1925 and 1930! Even the tinniest-eared nonmusician has more advanced ideas now than he did in those days. Times do change. You wouldn't know it, to look at these records.

Nevertheless, they are important as the first major excursions into an uncharted consumer field. We must watch them closely.

Of the group here considered, only one series seems to me to be worth adult attention, that put out by the Book-of-the-Month Club. Look at the others first.

Music Plus. Vol. 1, No. 4, Mendelssohn: Midsummer Night's Dream, op. 61. Austrian Symphony Orch., H. Arthur Brown. Comment by Sigmund Spaeth.
Remington MP 100-4

Music Plus. Vol. 1, No. 20. R. Strauss: Don Juan (cond. Kurt Woss); **Waltzes from "Der Rosenkavalier"** (cond. H. Arthur Brown). Austrian Symph. Orch. Comments, S. Spaeth. **Remington MP 100-20**

If Remington's bid for success succeeds, it looks as though our musical taste will be moulded by millions of these records! Already there are nearly thirty releases, each a full LP record, and all of these are ambitiously labeled "volume 1." Presumably there will be many another.

The format is simple. Complete performance first, uninterrupted—a clearly desirable and adult necessity. Commentary, with occasional illustrations, on following bands. The musical illustrations are evidently excerpted direct from the original tapes or from disc tests.

The over-all technical quality is only so-so, though acceptable enough for listening. The Spaeth comment is humorous, superficial, amusing, really of no very great interest to those who want to know more about the music. Indeed, most of it, in the old tradition of "appreciation" is (a) about the "story" or (b) about the background circumstances of the piece. There is no mention whatever of harmonic structure and very little of any other sort, except by occasional themes or tunes. That, too, is in the old tradition. The musical excerpts are rudimentary, usually being faded out in mid-music as the voice speaks; sometimes the fades are distressing, to say the least, to an old trouper who has had to cope with the excerpting problem these many years. It can be done, painlessly and musically.

But these are minor criticisms and on the whole, Dr. Spaeth's running comment is easy enough to listen to, not objectionable in any special way, not too weighty, not snobbish. The trouble is, I guess, that it really is not much of anything.

Isn't it about time we all grew up? I mean really up? This sort of thing doesn't honestly make for intelligent music appreciation—it has not a fraction of a per cent of advantage over straight listening to the music itself. It may amuse, it will not instruct. As far I am concerned, the whole venture is a rather large and amiable waste of time, though you surely have the right to disagree with me about its direct benefits—and, indeed, I urge you to take advantage of Remington's low prices to try out a couple on yourself. Try the whole list and you'll have a fine picture of musical taste as it existed 25 years ago.

The RCA Victor Listener's Digest. Asst. music and orchestras. 10 45's boxed, with booklet.

RCA Victor is a curiously persistent outfit. Once an idea, always. I can't remember when the last set of Victor musical shortcut condensations came out, on 78's, but I'll bet there was still an earlier set sometime back in acoustic days! Maybe the Readers' Digest got the idea there.

Anyhow, this is the same old stuff in a new format. But I can't entirely make light of it—for much as I despise the idea that good music can be boiled down for quick consumption—I'll admit that in the present state of our musical taste, many of us could not detect the cuts and the digesting. If so, then RCA wins a technical knockout. In fact, I tried this out on myself and on others.

I'll admit that in a good many familiar musical movements I just plain missed the place or places where the excision was made, and found myself—much too soon—at the final musical passages wondering how on earth we had got there so quickly. But in other places I was horrified at the cuts. Some just plain make hash of melodies, or cut out anticipated music like ice cream that falls off the spoon just at it reaches your mouth. Other cuts made tortured madness out of the musical form of a well built piece, notably the Brahms First Symphony, which is horrible in the cut form.

Again—why? What kind of intelligence is this appealing to? Does anybody really think that by patching out huge hunks of a piece you can get to know it more easily? Yes, in a very superficial way you can. But once learned, you'll have to re-learn the whole music when you hear it complete. And don't think that this digesting is of the sort that applies to the Readers' Digest. There, a continuous tailoring job is done, sentence by sentence, boiling down each phrase, each idea, pruning all the way along, but keeping the main structure intact. Here, the opposite procedure is followed; huge hunks of structure are simply omitted; the parts that remain are left unpruned, joined together arbitrarily at convenient harmonic connections.

For those who believe in shortcuts of the music appreciation variety, these records are as alluring as any. This sort of thing is big business in our country and RCA Victor is merely cashing in on a going thing, for which it can not basically be blamed. But better musical understanding would make these shortcuts unnecessary and unlikely.

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Be it noted, in passing, that most of the recordings here digested are low-fi and elderly, though musically excellent. (Presumably RCA did not ask St. Peter for the late Artur Schnabel's and Frederick Stock's permission to "digest" their joint Beethoven Emperor Concerto with the Chicago Symphony.) The technique apparently is to transfer the complete version to tape, then edit. Easy enough. A fine set of performances and I suggest that a "Music Appreciation History" with these recordings complete on LP's would be of more interest, even low-fi.

Beethoven: Symphony #5: Book-of-the-Month Club Music-Appreciation Record. Spoken Analysis: Thomas Scherman, members of M.A.R. Orch. Written notes: Deems Taylor. Complete playing: London Symphony Orch., Norman Del Mar. (Available only via club membership).

Here is the beginning of another series, outwardly similar to that from Remington (Music Plus) but vastly more adult and more effective. Here, too, the complete performance is played separately, in this case a very adequate rendition (a few hurried places, not well rehearsed perhaps) from England. Here, too, the spoken commentary is separated, with musical illustrations along with the voice.

But here, the musical examples are not merely taken off the main performance. Instead, they are specially played, by a different orchestra. Excellent advantage is taken of the possibilities thus offered, to play, for instance, only part of an orchestration, the accompaniment alone without the melody, or a passage as it might sound with an altered rhythm. Moreover, this commentary, instead of an amiable and loose-jointed talk with a few bits of sweet music along the way, is designed, as it should be, specifically to match up the words and the music, to play the exact passage that is under description, the motive, the idea, the instrument, as it is mentioned.

Now this is common sense. It is the only way to do it. Indeed the only excuse whatsoever for having spoken commentary, instead of written notes (so much faster and more efficient), is to tie the music and the comment together securely. Only in this way can we identify ideas, passages, themes, positively and immediately. Written notes can only generalize, or take refuge in notation (which most of us can't read) or in measure numbers, which of course are entirely useless without a score and a score-reader.

Naturally, it costs a lot to assemble a special orchestra to make these musical illustrations. It doesn't have to be done this way, as this writer knows well enough; you can do a whale of a lot with plain excerpts from the complete recording. But there are advantages, and Mr. Scherman knows them. You'll hear some passages on these records that you'll never hear anywhere else—a real "inside view" of the score.

The technique, evidently, is to record all of the desired illustrations, then dub them off onto the master tape along with the voice. The job is a bit clumsy here; reverberation at the end of each example is cut off prematurely with an unpleasant suddenness. Easily remedied. Recording on the analysis side is poor, as though done a cheap home tape recorder. Some distortion, highs very limited. Doesn't interfere with the sense at all, but the Book-of-the-Month Club could do better. (The complete performance, on the reverse, is technically OK.)

You'll find Mr. Scherman's comments entirely adult and of a good deal of really serious interest, though he is not the best of speakers. He stresses the dramatic and motival structure of the music, the rhythms, the emotional preparations, and makes good mention of details of orchestration, being himself a conductor. I would criticize (on a high plane) the lack of any treatment of the harmonic side of Beethoven's structure which is surely the very rock on which all else is built. No mention of keys, key-relationships, key-contrast.

Deems Taylor supplies written commentary on the background of the music—an excellent idea, complementing the direct spoken treatment of the actual music.

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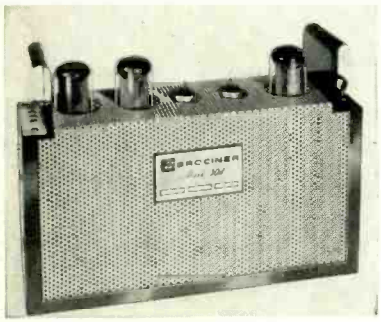
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NEW PRODUCTS

● **Thirty-Watt Amplifier-Control System.** Printed-circuit technique, pioneered by the company in its Mark 12 amplifier, is used throughout in the new Mark 30A power amplifier and the companion Mark 30C control center recently introduced by Brociner Electronics Laboratory, 344 E. 32nd St., New York 16, N. Y. The power unit is rated 30 watts at 1 per cent intermodulation; at 20 watts, intermodulation is less than 0.2 per cent, and below this level it quickly reduces to a point at which it is virtually unmeasurable. This unusual performance is achieved through use of 45 db of multiple-loop negative feedback. The entire chassis measures only 3½ × 12 × 9 ins. Two 6881's are used in the output stage.

The Mark 30C preamplifier is self-powered and provides complete control facilities, including separate turnover and roll-off control for record compensation, continuously adjustable bass and treble controls providing both boost and cut, and a loudness control. Loudness compensation





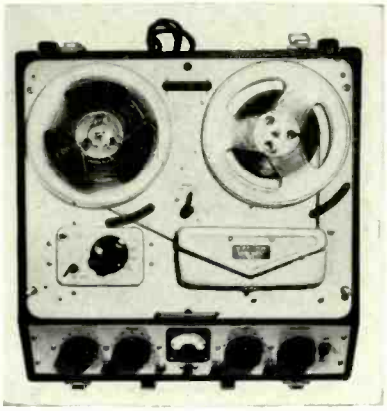
may be conveniently removed when desired by means of a front-panel switch, without affecting volume level. Negative feedback circuits reduce intermodulation to less than 0.1 per cent for outputs as high as 4 volts.

● **Tiny Toroid Coil.** Design and development engineers will find great interest in a new "Postage Stamp" toroid coil being produced by Hycor Company, Inc., 11423 Vanowen St., North Hollywood, Calif. The coil consists of a sub-miniature molybdenum permalloy toroid core with a winding having a residual hole as small as 1/16 in. Windings are impregnated with a special compound and the finished coil is encased in a tough epoxy plastic. Dimensions are 13/16 × 13/16 × ⅜ in. Resembling in



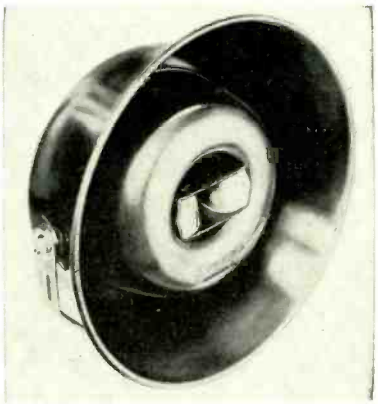
appearance a small molded mica capacitor, the unit is available in any inductance up to 1 hy. Useful frequency range covers 1500 cps to 150 kc, dependent upon the inductance value.

● **British-Made Tape Recorder.** Three drive motors, wide-range frequency response, automatic shut-off is unattended operation, instantaneous start and stop control, separate bass and treble controls,



and metered input control are among the features of the Ferrograph tape recorder. The Ferrograph uses standard quarter-inch tape, operates at either 3.75 or 7.5 ips, and is equipped with dual-track recording heads. Rewind time for a full 7-in. spool is one minute. A built-in preamplifier enables the machine to make full-depth recordings from input signals as weak as .003 volt peak. Audio output is 2.5 watts. The unit is equipped with a built-in speaker for monitoring, and also an output jack for feeding external speakers when desired. The entire recorder is self-contained in a portable carrying case. Made in England, the Ferrograph is distributed in the United States by Hudson Radio & Television Corp., 48 W. 48th St., New York 36, N. Y.

● **Weatherproof Coaxial Speaker.** Excellent reproduction of both voice and music is brought within the reach of every public-address installation by the new Univer-



sity Model BLC speaker system. Based on the design of University's Model WLC dual-range outdoor theater system, the new speaker is smaller and more compact, measuring 22½ ins. in diameter with a depth of only 9 ins. It comprises a low-frequency driver coupled to a balanced compression-type exponential horn, and a separate tweeter coupled to a wide-angle horn incorporating University's patented "reciprocating flares" principle. A built-in dividing network provides for crossover at 2000 cps. Rated frequency response is 70 to 15,000 cps. Continuous-duty power rating is 25 watts. The unit is fully weatherproof and of exceptionally rugged construction. Input impedance is 8 ohms. Literature will be supplied on request by University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y.

● **Transistor Oscillator.** Completely self-contained, including batteries and output meter, the new General Radio Type 1307-A Transistor Oscillator is a pocket-size source of test voltage at 400 and 1000 cps. The first instrument to result from the company's developmental program in transistor circuits and their applications, the oscillator delivers maximum output of at least two volts across a 600-ohm load. Output voltage is adjustable and may be read on the meter. Among applications of the 1307-A are checking the sensitivity of oscilloscopes and other instruments, cali-



brating measuring equipment, making continuity checks, and powering audio-frequency bridges. Output voltage is set by means of an adjustable resistance in series with the battery supply, thus conserving battery life when only low output is needed. Under average conditions, battery life is more than 100 hours. General Radio Company, 275 Massachusetts Ave., Cambridge 39, Mass.

● **FM-AM Tuner-Amplifier.** A complete high-fidelity music system is comprised in the new Model 5001X FM-AM tuner with separate power amplifier recently announced by Scott Radio Laboratories, Inc., 1020 N. Rush St., Chicago 11, Ill. Included in the circuitry is automatic frequency control and a newly-designed selector switch for automatic level and frequency compensation to meet various recording standards. Amplifier response is essentially flat from 30 to 15,000 cps at rated output of 20 watts. The Model 5012X tuner is identical except that it is designed for operation with any standard power ampli-



fier. It terminates in a cathode-follower output and can be interconnected with relatively long leads where desired. Engineering bulletin describing the Series 5000 will be mailed on request.

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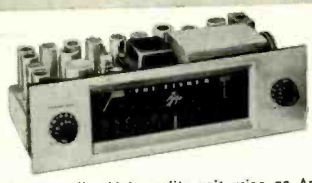
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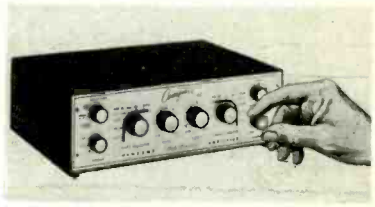
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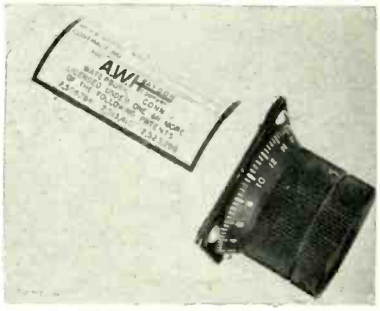
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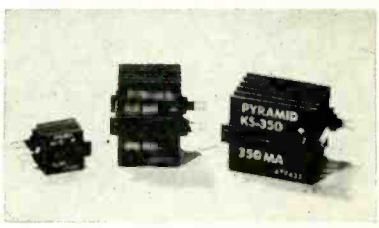
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● **Time Delay Relays.** The A. W. Haydon Company, 232 North Elm St., Waterbury, Conn., is offering Bulletin AWH TD500 describing its new line of special time relays. Being motor driven, these units provide accurately controlled time delay periods adjustable over a wide range. The time delay period can be adjusted in 0.2-second intervals over the range from 2 to 30 seconds, and a positive detent arrangement maintains the time setting under all conditions of operation. Motor starting



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● **Selenium Rectifiers.** Claimed to be a new and revolutionary design, a new series of selenium rectifiers is now in production at Pyramid Electric Company, North Bergen, N. J. The new construction features edge-mounted plates providing full air circulation between plates, light constant contact pressure which eliminates center hot spots, rigid construction



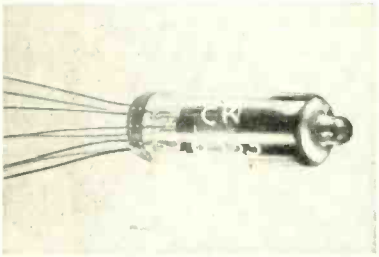
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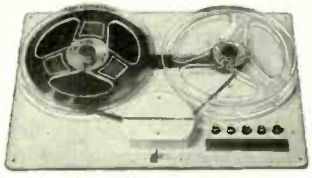
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★ Accommodates 1750' reels (8").

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Book Review

HARMONICS, SIDEBANDS AND TRANSIENTS IN COMMUNICATION ENGINEERING, by C. Louis Cuccia, McGraw-Hill Book Company, Inc. New York, 1952. ix + 465 pp. $9.00.

In compact form, this book presents the working tools of the communication engineer. In the words of the author ". . . this book has been written to provide not a collection of solutions but rather an organized and integrated textbook, dealing simultaneously with the Laplace, Fourier, and Taylor analyses." In general the aims of the author have been carried out. The book is well suited to senior and graduate level courses in communications, and will be most useful to the practicing engineer who will find some new approaches to familiar problems.

The subjects range from noise in vacuum tubes through wave interference in FM transmission, to traveling waves on lines and in the magnetron. Such a large variety of topics are discussed that to outline them would be beyond the scope of this review. Although much of the book is not directly concerned with radio, many of the subjects do affect audio signal transmission.

In audio, in the section on distortion and harmonics amplifiers, the analysis is carried out in the light of both Taylor and Fourier series representations. This approach provides two methods and enables the most suitable analysis technique to be applied to any given problem. Related subjects include multitone FM, network transient response, and finite wave trains, the last being more concerned with video than audio. There seem to be no important omissions, but some of the material such as oscillator operation, the blocking oscillator, and transistors, receive scant consideration.

Notwithstanding its few lean areas, this work should be an invaluable aid to the communication engineer and an excellent textbook.

—Lewis S. Goodfriend

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SHOW SHOTS—

Permoflux Innovation

With the introduction of a new idea in merchandising their line of loudspeakers and enclosures as complete units, Permoflux Corporation, Chicago, collected registration cards from the visitors to their exhibit room at the International Sight and Sound Exhibition. At the conclusion of the show, a drawing was held to determine the recipients of five Permoflux speaker systems. The photograph at the left, above, was taken during the drawing while Gordon Hough, supervisor of the Hi-Fi Salesrooms at Allied Radio, selected the first of five prize-winning names. Mr. Hough, with his hand in the box, is being watched (from left to right) by L. M. Eugene, Permoflux' advertising manager, C. G. McProud, editor of AUDIO, F. J. VanAlstyne, Permoflux jobber sales manager, and Sanford R. Cowan, AUDIO's midwest advertising representative.

Permoflux' new idea was the HTP—an Insured Home Trial Plan—under which either a Largo or a Diminuette speaker may be tried in the home for 15 days, and returned for full refund if the speaker system does not meet the user's requirements.

British Industry Guests

The photograph at the right shows Hector Slade (left), managing director of Garrard, and Leonard Carduner, president of British Industries Corp., during an interview at the Audio Fair in New York for Fred Grunfeld's WOR-Mutual's weekly radio show, "Musical Almanac." The program, aired on the network Oct. 30 and locally over WOR in New York on Oct. 31, included tape-recorded music and interviews with exhibitors and guests at the Fair. Another exhibitor's product was represented in the photo, although barely seen. This was the Magnecord Voyager tape recorder used by Mr. Grunfeld (with headphones) and Arthur Kendy, director of the show. The Voyager is a lightweight unit particularly adaptable for out-of-studio recording. (It is only by coincidence that Permoflux is mentioned above, since the headphones happen to be permoflux.

British Industries Corp. is the importer of Garrard record changers, Leak amplifiers, Wharfedale loudspeakers, and Multicore solder. Harold Leak and Wharfedale's G. A. Briggs were both in attendance at the show, and were kept busy with the questions of visitors.

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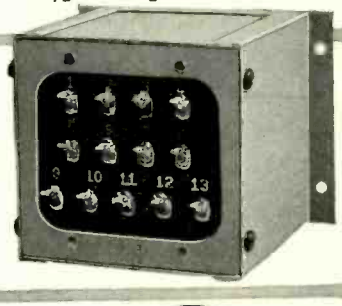
Type FA-14-A. For Flexibility on Multi-line Remotes **$62.50**

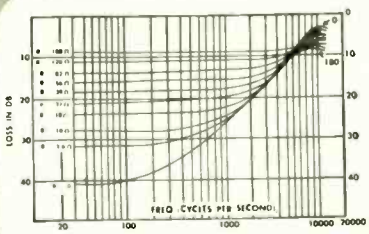
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PHONES FOR FIDELITY

(*from page 24*)

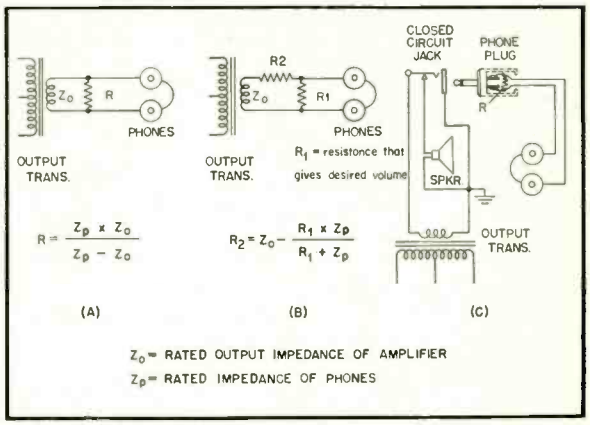


Fig. 6. Connection diagrams to determine the value of terminating resistors.

with a limited budget can put off buying an expensive amplifier, loudspeaker, and enclosure until such time as he can afford them, meanwhile listening with phones when he wants high fidelity and using the amplifier and speaker of any old radio when he wants background music or voice reproduction. Phones can be used with many preamplifiers and tuners. The requirement is a low-impedance (10,000 ohms or less) output stage, consisting of a cathode follower or a medium-mu triode. Units with a volume control after the output tube are unsuitable unless the volume control is set at maximum. The output coupling capacitor should be at least 0.1 μf for use with crystal phones, or 0.25 μf for dynamic or magnetic headsets. Crystal phones may be plugged in directly, but they should be shunted by about 100,000 ohms to prevent a d.c. charge. Phones with an impedance of 15,000 ohms or less must be connected through an output transformer for good results. The primary impedance should be 20,000–25,000 ohms and the secondary should be less than or equal to the rated impedance of the phones. If it is too much less the volume may be insufficient. Even a cheap transformer may be used because it is driven by a low impedance and the power is small.

For binaural operation separate connections must be made to each phone. Suitable flexible cords may be made up or purchased. The cords may be terminated with any of several types of connectors, such as four phone tips, two phone plugs, two phono plugs, or a single four-contact plug. Whatever form of connection is used, a means of easily and quickly reversing the connections to one phone without changing those to the other should be provided. This is necessary in order to allow the phase of one channel to be equated to that of the other, that is, a sound source equidistant from both microphones should cause the earphone diaphragms to move in and out together. If one moves in while the other moves out, the full binaural effect cannot be achieved. By reversing the polarity while listening it is usually possible to determine which connection is correct. No permanent connection should be made because the phase relationship may vary between different broadcasts and recordings. Reversibility of the polarity of one channel is most easily and economically accomplished by using four phone tips. A more convenient arrangement employs two non-polarized plugs, on for each channel. Reversing either plug in its socket changes the polarity. Alternatively, two polarized plugs and three sockets may be provided. Two sockets are connected to the same channel but with reversed polarity. If this system is used, the same headset can serve for monaural reception of the two-socket channel without altering the cords or connectors. Another method is to use a double-pole double-throw reversing switch in one circuit.

Conclusion

While loudspeakers offer many advantages not shared by headphones, the serious music listener should consider using phones as a means of high-fidelity reproduction. They permit listening without disturbing others and reduce the disturbance to the listener by others. They avoid room resonances, standing waves, reverberation and treble beaming.

In the writer's opinion, when listening to full orchestral and/or highly reverberant music it is easier to adjust to the within-the-head localization of headphones than to the "hole in the wall" localization of the usual speaker system. For listening to binaural or even two-channel stereophonic programs, phones are far superior to speakers.

High-fidelity headsets are available and should be selected on the basis of listening tests. They are easily connected to the output transformer or even to a tuner or preamplifier, and conversion for binaural reproduction is simple.

The writer wishes to thank the Permoflux Corporation, the Brush Electronics Company, and Telex, Inc., for their assistance in making available photographs and information about their products.

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ABOUT MUSIC

(*from page 12*)

The salute to the "great men of the past," more specifically, may be found in Strauss' allusions to the *Eroica* Symphony and *Tristan*. Only in the last bars does Strauss use Beethoven's theme in a literal sense, and when he does, it becomes even more compelling. Scored for twenty-three solo strings, *Metamorphosen* was described by the composer as a "study." But don't let this frighten you off. This is no austere working out of contrasting string choirs. On the contrary, it harks back to the slow movements of Beethoven's last string quartets in its humanity and expressiveness. This long, impressive *Adagio* is unique in Strauss' output, not only because of its unusual scoring, but also because of the solemn, masterly unfolding of deeply-felt melodic ideas.

Lovers of woodwind music will enjoy the *Duet Concertino* (1947) for clarinet and bassoon. Tricky rhythms, unexpected harmonic progressions, and an eighteenth-century approach to ensemble writing which resembles the *concerto grosso* form, all contribute to the work's appeal.

"I am not at home in half light," Strauss once said, "I like the light." As a result, he was almost a seasonal composer, needing the sun to encourage his creative mind. He really came into his own during the warm months when he could enjoy the magnificent sun-filled mountains surrounding his Upper Bavarian home. In the winter, he composed very little, spending most of his time revising and copying out scores he had accomplished during the preceding months. Strauss' love of light and clarity increased with the passage of time and affected each composition until, in his last years, his music resembled the golden crystal brightness of a vintage brandy.

COMING EVENTS

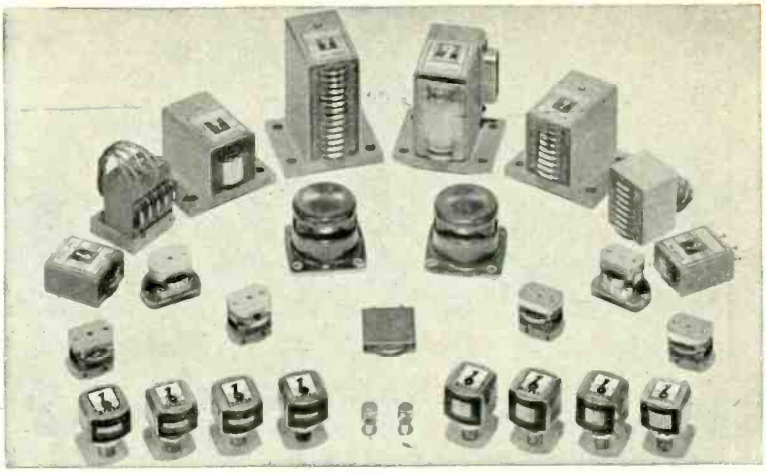
Nov. 18–19—Sixth Annual Electronics Conference sponsored by the Kansas City Section of the I.R.E., Hotel President, Kansas City, Mo.

Nov. 30–Dec. 2—First Electronic Computer Clinic, 244th Regiment Armory, New York, N. Y.

Dec. 8–10—Eastern Joint Computer Conference and Exhibition, sponsored by I.R.E., A.I.E.E., A.C.M. Bellevue-Stratford Hotel, Philadelphia, Pa.

Jan. 20–21—Symposium on Printed Circuits, sponsored by R.E.T.M.A. Univ. of Penn. auditorium, Philadelphia, Pa.

Feb. 10–12—Audio Fair—Los Angeles, Alexandria Hotel, Los Angeles, Calif.



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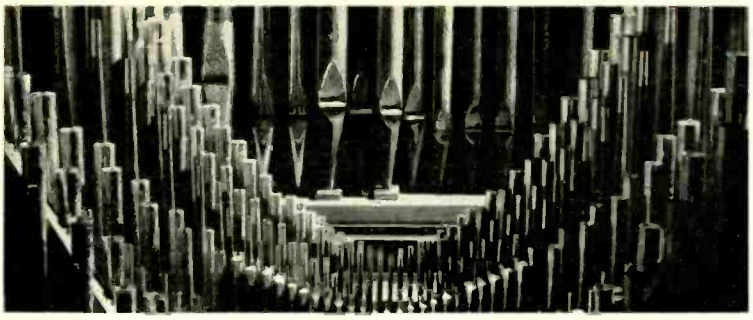
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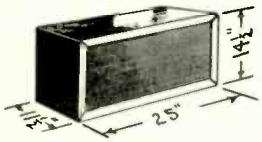
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* Patent applied for by Edgar M. Villchur.

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AUDIO, published Monthly at Lancaster, Pa., for October 1, 1954.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher: Charles G. McProud, 204 Front St., Mineola, N. Y.; Editor: Charles G. McProud, 204 Front St., Mineola, N. Y.; Managing editor: none; Business manager: Henry A. Schober, 204 Front St., Mineola, N. Y.

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(Signed) HENRY A. SCHOBER, Business Manager.

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(Seal) STUART C. EATON, Notary Public.

State of New York. No. 44-6138200. Qualified in Rockland County. My term expires March 30, 1956.

AMPEX IS TEN

Ampex Corporation, Redwood City, California, celebrated its tenth anniversary with a dinner in honor of Alexander M. Poniatoff, its president and founder, on Tuesday, November 2, and further commemorated the occasion by presenting him a ten-year service pin.

Ampex was founded November 1, 1944, by Mr. Poniatoff as a manufacturer of precision permanent-magnet motors and generators used in airborne radar scanning devices. Cancelled contracts at the end of World War II demanded the search for a suitable postwar product—a search which ended when Mr. Poniatoff saw a demonstration of the Magnetophon, a German tape recorder. Harold Lindsay and Myron J. Stolaroff, leading engineers of the company, began development of the first Ampex recorder in April, 1947, built the first machine by February, 1948, and described it in AUDIO ENGINEERING in October, 1948.

The first twenty Ampexs were sold at $4000 each to Bing Crosby Enterprises—still an important Ampex distributor—who later sold them to ABC.

Since 1948, Ampex has grown from eight employees to more than 500, and now occupies two plants with over 75,000 sq. ft. of space, with an additional 30,000 nearing completion. The myriad uses to which tape recording can be put points to still further success for Ampex.

Employment Register

Personnel may be listed here at no charge to industry or to members of the Audio Engineering Society. For insertion in this column, brief announcements should be sent to Chairman, Employment Register Committee, P. O. Box 629, Mineola, N. Y. before the fifth of the month preceding the date of issue.

★ Positions Open ● Positions Wanted

★ **Recording Engineer Wanted.** Large recording company is looking for a sound engineer who is well experienced in transferring and editing tapes to LP masters. Must be able to read music; prefer married man. Location: New England, will pay moving expenses. Only completely qualified man need apply, giving experience in detail. Box 1101, AUDIO.

★ **Audio Sales Engineer.** Midwest distributor of sound equipment has opening for experienced salesman to work with architects and electrical contractors specifying and supplying systems. Business is now established and applicant must be able to command income from $8000 to $10,000. Apply, giving full resume, to Box 1102, AUDIO.

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● **Audio Research Engineer.** Experienced in microphone development for 15 years, physics of precious metals for 5 years. Desires appropriate position in metropolitan New York or elsewhere. Box 1104, AUDIO.

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RUMBLE REDUCTION

(from page 32)

+180 volts without exceeding the tube's rating. Such biased heater supplies should be heavily bypassed to ground.

With the equipment available the writer was not able to measure attenuation at the rejection frequency because of distortion in the audio oscillator used. It was estimated to be in excess of 25 db below the region of flat response. Using again the response in the flat part of the range as zero level, the output was down approximately 1 db at 36 cps and 6 db at 32 cps when the rejection frequency was adjusted to 30 cps.

Higher-Q filters employ cathode-followers in the feedback loop were tried, but were too sharp in cutoff unless two or more were stagger-tuned. With just one such filter, the rumble frequency would vary enough to rear its ugly head periodically on each side of the rejection frequency.

A twin-T used as a brute force filter is unsatisfactory because it has an effective Q of only ½ and affects the response up to several hundreds cps.

The circuit presented here, incidentally, permits one to use test records for adjusting equalization without having rumble render the results unintelligible.

It is fortunate that the major component of rumble, for the motors considered, is so low, because any attempt to "poke a hole" in a pass band does give transient troubles. As has been pointed out, very few records (or for that matter, very little music) have frequencies down to 32 cps. So if we eliminate a few cycles starting at this point, we are not tampering with the really usable band.

Though some purists may insist that because they can hear down to 15 cps and their speaker has useful output this low, they want to equalize correctly to such a point, the simple fact is that they will probably have to use signal generators for such dubious aesthetic flights. For those whose turntables have two pole motors (thus placing the rumble in the neighborhood of 57 cps) we can only offer sympathy.

REFERENCE

Valley and Wallman, "Vacuum Tube Amplifiers," New York: McGraw-Hill Book Co., Chap. 10.

AUDIO for LIFE

See page 60

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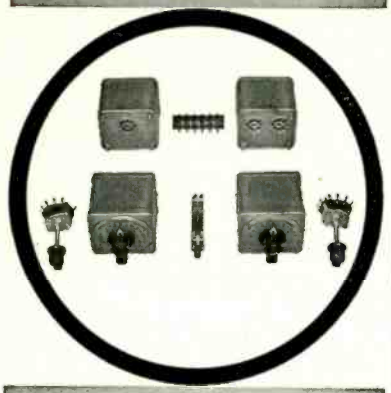
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LETTERS

[*from page 8*]

Live Music Exodus?

SIR:

Harold Lawrence's "Is Live Music on the Way Out?" (Sept. 1954) dusts off and shines up a theme which has intrigued many a composer and inventor—true blood brothers in different creative fields. That the omission of middle men—the performers and conductors—would pass unmourned by the composers and many a music lover goes without saying, and considerable progress has already been made to this end even without benefit of electronics.

Some of the great theatre organs, such as those in Radio City Music Hall and in the Atlantic City Auditorium, with their vast arrays of pipes, percussion instruments, and other varied effects, have come pretty close to this goal, although leaving much to be desired.

With the aid of electronics, these omissions can still be supplied, and I don't believe the added cost would be anything like a half million dollars. These great instruments are essentially organs, wherein dynamic epxression through keyboard touch is not possible, wherein true orchestral tone qualities are not developed, and wherein the ensemble effects of many like instruments in the various sections of an orchestra are not available.

If all of these were supplied, together with all of the percussion section, and such added effects as plucked strings, the composer—if he be a performer also—could convey his musical message just as he himself conceives it.

Add a collection of sound effects such as rippling brooks, crashing surf, the calls of birds, the human voice, and many others found in well-equipped broadcast stations or recordable on endless tapes, and you will have as much or more than any single individual could handle. Special "keyboards" such as Dr. Frederich Trautwein's Trautonium, or no keyboard at all as in the Theremin, would also provide glissando effects.

As to tonal characteristics, I pointed out in my paper "Electronic Music and Instruments" (Proc. I.R.E. Vol. 24, No. 11, Nov. 1936):

"The ideal instrument is one which can make any sound—known, unknown, or conceivable; to do this we must provide a generator for periodic vibrations embracing the whole audio spectrum of frequencies. We must be able to select from this generator at will any desired single frequency, or many single frequencies simultaneously, whether harmonically or inharmonically related, or whether in narrow or wide continuous bands. We must further be able to emit these frequencies in any desired sound amplitudes and envelope shapes, even though in a given sound all the components require different shapes of envelope. We must be able to control the emission of these sounds by some suitable playing technique and apparatus.

"With such apparatus we shall be able to synthesize any possible sound—continuous, damped, transient, musical or non-musical, for we have all the elements of sound and means for putting together any desired combination of these elements in any desired time-amplitude relationships. Looking ahead ten or twenty years, we are now at work on such an instrument."

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Improved Phono Circuits

(*from page 28*)

C_1 and R_3 combination in *Fig.* 2 (Fig. 1 of the previous article), equal to the bass pre-emphasis time constant of the recording characteristic. For the LP and Orthophonic characteristics this is 1590 and 3180 microseconds, respectively. The method for selecting these resistors suggested in the previous article makes the compensation correct for the extreme low frequencies at which the gain of the basic amplifier begins to become a limiting factor, but it does not make the compessation correct in the range covered by the majority of the bass-frequency components.

The method of connecting the switching-transient-eliminating resisitors shown in *Fig.* 1 is preferable to that given in the orginal article in that it places only one of these resistors in the feedback circuit at a time.

Ideally, the 0.12-meg resistor between S_{1A} and the first 12AX7 cathode should be shunted with a capacitance equal to 3.9/120 times the total capacitance to ground shunting the 3900-ohm cathode resistor. This point is simply a technical purism for a preamplifier using a tube like the 12AX7, but there might be some value in giving attention to it in a circuit which used a larger feedback ratio; e.g., a feedback bass-boost circuit in which the basic amplifier used low-mu tubes.

The author has received a number of inquiries regarding the possibility of adapting the triode preamplifier in the earlier article to include tone controls. With a bypass on the first 12AU7 cathode a tone control circuit with about 10-db insertion loss could be substituted for the loudness control. With the compensation adjustments provided by the revised circuits presented herewith, plus or minus 10 db of tone control should be more than adequate for all but the very unusual situation. The output section of the preamplifier should be redesigned if a greater range of tone control is required.

The variety of recording characteristics in use is now sufficiently great that one may dare to hope no new characteristic will appear which would make further revision necessary.

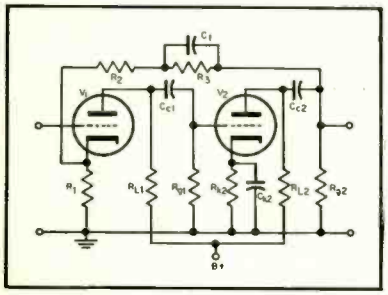
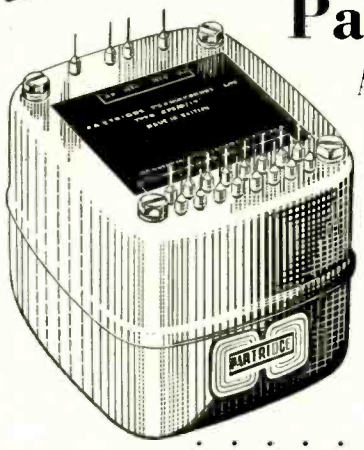


Fig. 2. Basic degenerative-bass-boost amplifier circuit. V_1 and V_2 and associated components, excluding feedback elements R_2, R_3, and C_1, comprise the basic amplifier. Triodes are shown for simplicity.

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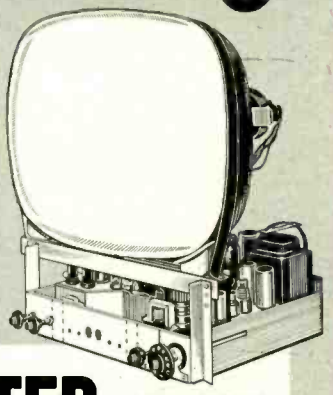
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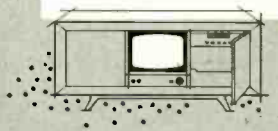
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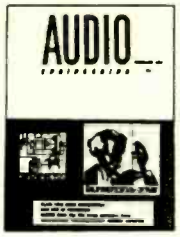
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AUDIO ETC.

(*from page 50*)

Varèse (who has some potent ideas) has bothered to tell us what musical language of expression he is going to use and what his form and system may be.

Yes, Hindemith wrote music on a mechanical piano roll, 'way back. But for some strange reason he gave up that plan and all similar plans, for a more old fashioned kind of music, played by live musicians. Old fuddy-duddy? No—merely one of the bigger musical minds of our time. It is just possible, you see, that the musical language as it now exists, in all its forms and complexities, an inherited product of a thousand years of development (and hundreds of thousands before that of "folk music" background), is not suited to the new tool. It is based, remember, on pitch, on rhythm, on motives, pitch-and-rhythm ideas. Tone color is definitely secondary. No piece of music has ever stood up to greatness based on a mere play of tone color, without other organization. *What other organization?* Pitch. Rhythm! Even twelve-tone music clings tenaciously to these elements.

Do we need new sources of pitch and new rhythms to carry on the present musical inheritance? That is one question now under hot debate. Most musicians feel that the delicately exact, ultra-human sound-expression of our present instruments, far from being a draw-back to freedom, is the very basis of human expression in musical terms. There is not a one of the instruments that is not capable of human expression, by proxy. And they took centuries to evolve.

Can the taped sound of machines, thunderstorms, a million-odd natural sounds and a million more contrived ones, serve musical expression, music *sense and order,* better than the highly developed, enormously specialized living instruments of existing music, played by living people-in-action?

Frankly, I doubt it. Not, at least, without a period of new development that by all reasonable thinking should last perhaps for a century. Even at our accelerated rate of development, a century is nothing to develop a whole new expanse of musical tools, even if the present basic inheritance of musical language is to continue to evolve.

But if we are to junk present pitch, present form, along with present instruments, if we are to work out new sound-languages, new human expressions, then we must set ourselves for a far bigger job, as great as the entire effort in the long development of Western music to date!

Does this bother the proponents of *la musique concrète?* Not a bit, of course. We are in the first stages of the grand experiment and it is of the essence of experimenters to be brash, cocky, utterly sure of themselves! Edgard Varèse is as sure of the future of his own experiments as the famous Florentine *camaratax* ever was, that group of fancy musical amateurs who first turned out a preposterous new kind of music to be called *opera.* Their experiments make pretty awful listening—now, too, in case you haven't heard them.

Yes, there is something wrong with the composing machine. It hasn't learned how to compose music yet.

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Industry People . . .

AUDIO FAIR FLASHBACK: G. A. Briggs, designer of Wharfedale speakers, being interviewed by namesake **John Briggs,** music critic for the New York Times . . . **Richard Dorf,** author of the forthcoming book, "Electronic Musical Instruments," demonstrating a two-manual organ he built from scratch in less than six weeks—no slouch of a musician, he . . . Speaker used with Dorf's organ was the fundamentally new unit developed by **Edgar M. Villchur** and described in the October issue of AUDIO . . . **Hermon Hosmer Scott** checking visitor reaction to his company's new three-speed turntable.

Maurice Meshboum, whose hi-fi set-up is just about the finest in the Windy City, keeping intact his record of never having missed a New York Audio Fair . . . **Chet Wharfield,** who heads up the Sound Department of Chicago's Allied Radio Corporation, on the receiving end of an interview by **Beatrice Freeman,** feature writer for the New York Times . . . **Larry LeKashman** beaming over the reception accorded the new Electro-Voice speaker and amplifier lines . . . **John Boyers, Spec Barker,** and **Dick McQueen,** who last attended an Audio Fair as officials of Magnecord, Inc., still together as executives of National Company, Inc.

Tom Nicholson, who heads up high-fidelity operations for General Electric Company, optimistic over growing demand for the new GE coaxial speaker . . . **Russ Tinkham,** Ampex general sales manager, and **Bob Paulson,** audio sales manager for the New York district, explaining to friends that absence from the Fair of Ampex and manager **Jim Ford** was due the arrival of **Cynthia,** the **Fords'** first heiress, who is at present conducting an Audio Fair all her very own . . . **Barris Hamilton Hill Mitchell,** audio and recording authority associated with the New York office of the British Information Services, ogling latest models of long-duration tape recorders . . . **Nat** and **Chuck Mendelsohn,** long-time audio fans, participating in the Fair for the first time professionally as proprietors of Music Age, Inc., lavish hi-fi establishment at Paramus, N. J. . . . **Ed Cornfield,** formerly sales manager of Pilot Radio Corporation, announcing his newly-acquired partnership in Orfeo, the high-fidelity shop at 19 E. 48th St., in New York City . . . **Leon Adelman,** national sales rep, joining with **Walter Jablon,** sales manager, in due expression of pride over new Freed-Elsemann line of tuners and amplifiers . . . **Leon Wortman** announcing his new association with the J. C. Warren Corporation, Freeport, N. Y., as sales manager—formerly with RCA-Victor Division in Camden . . .

Frank Robbins and **Bill Joseph** sharing with friends their elation over issuance of patents covering the R-J speaker enclosure, which they invented two years ago—they plan now to proceed with legal action against infringers . . . **Floyd Bell, H. K. Seay,** and **Jim Pickett** huddling over sales and ad program for the impressive new Bell tape recorder.

Industry Notes . . .

The Institute of Radio Engineers has named Harald T. Friis, director of radio research, **Bell Telephone Laboratories,** Red Bank, N. J., as recipient of the IRE Medal of Honor, the highest technical award in the radio engineering profession. The Morris Liebmann memorial prize will go to Arthur V. Loughren, director of research, **Hazeltine Corp.** Winner of the Harry Diamond memorial award is Bernard Salzberg, **Naval Research Laboratory,** Washington, D. C. Formal presentations will take place during the annual IRE convention in New York City next March.

Four subcommittees to study standardization problems and recommend procedures to be adopted have been set up by the **Standards and Engineering Committee** of the **Magnetic Recording Industries Association,** which held its second annual meeting in New York City during the Audio Fair. Association members who have been assigned chairman of the groups are C. J. LeBel, Russell Tinkham, Arnold Hultgren, and Clarence Sprosty. The Standards group is headed by Robert Leon of Brush Development Corp. MRIA president Joseph R. Hards has asked the subcommittees to report back to the membership by the first of the year.

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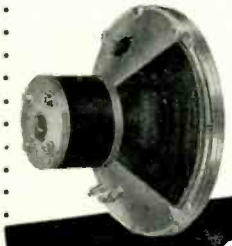
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All you need for a fine hi-fi system is incorporated within the Consolette Jr. . . . a fine record player—either the Collaro automatic record changer or the manually operated Bogen precision record player; a newly designed audio amplifier—the Bogen HF-8; the most talked-about hi-fi speaker in years—the University 8" coaxial. These elements are incorporated into the most functionally correct setting possible. Available in Mahogany - Walnut - Blonde.

Consolette JR-A with Collaro changer $237.50 | **Consolette JR-M with Bogen player $229.50**

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It's *not* too late for Americans who go to their doctors at the *first sign* of any one of cancer's 7 danger signals: (1) any sore that does not heal (2) a lump or thickening, in the breast or elsewhere (3) unusual bleeding or discharge (4) any change in a wart or mole (5) persistent indigestion or difficulty in swallowing (6) persistent hoarseness or cough (7) any change in normal bowel habits.

Guard yourself against cancer. Phone the nearest office of the American Cancer Society or simply write to "Cancer."

American Cancer Society

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FREQUENCY RANGE: 20-20,000 cps
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MINIMUM AMPLITUDE VARIATION
LESS DISTORTION

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THE STANDARD OF COMPARISON FOR OVER 20 YEARS

HIGH FIDELITY TRANSFORMERS

FROM STOCK... ITEMS BELOW AND 650 OTHERS IN OUR CATALOGUE B.

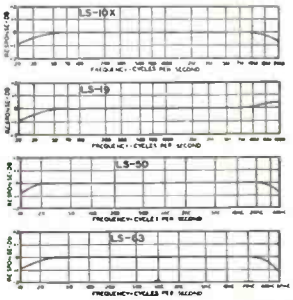
TYPICAL UNITS

LINEAR STANDARD series

Linear Standard units represent the acme from the standpoint of uniform frequency response, low wave form distortion, thorough shielding and dependability. LS units have a guaranteed response within **1db. from 20 to 20,000 cycles.**

Hum balanced coil structures and multiple alloy shielding, where required, provide extremely low inductive pickup.

These are the finest high fidelity transformers in the world. 85 stock types from milliwatts to kilowatts.



LS-10X Shielded Input
Multiple line (50, 200, 250, 500/600, etc.) to 50,000 ohms . . . multiple shielded.

LS-19 Plate to Two Grids
Primary 15,000 ohms.
Secondary 95,000 ohms C.T.

LS-50 Plate to Line
15,000 ohms to multiple line . . . +15 db. level.

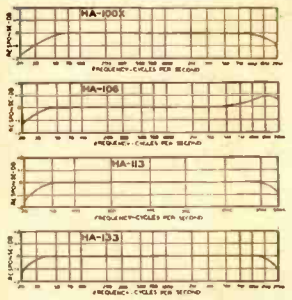
LS-63 P.P. Plates to Voice Coil
Primary 10,000 C.T. and 6,000 C.T. suited to Williamson, MLF, ul.-linear circuits. Secondary 1.2, 2.5, 5, 7.5, 10, 15, 20, 30 ohms. 20 watts.



CASE	LS-1	LS-2	LS-3
Length	3⅛"	4-7/16"	5-13/16"
Width	2⅝"	3½"	5"
Height	3¼"	4-3/16"	4-11/16"
Unit Wt.	3 lbs.	7.5 lbs.	15 lbs.

HIPERMALLOY series

This series provides virtually all the characteristics of the Linear Standard group in a more compact and lighter structure. The frequency response is within 1 db. from 30 to 20,000 cycles. Hipermalloy nickel iron cores and hum balanced core structures provide minimum distortion and low hum pickup. Input transformers, maximum level +10db. Circular terminal layout and top and bottom mounting.



HA-100X Shielded Input
Multiple line to 60,000 ohm grid . . . tri-alloy shielding for low hum pickup.

HA-106 Plate to Two Grids
15,000 ohms to 135,000 ohms in two sections . . +12 db. level.

HA-113 Plate to Line
15,000 ohms to multiple line . . . +12 db. level . . . 0 DC in primary.

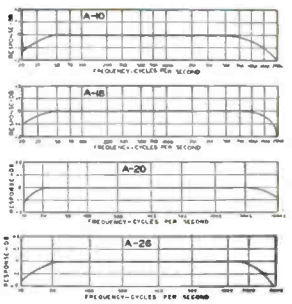
HA-133 Plate (DC) to Line
15,000 ohms to multiple line . . . +15 db. level . . . 8 Ma. DC in primary.



Case	H-1	H-2
Length	2⅜"	3-9/16"
Width	1-15/16"	2-13/16"
Height	3⅛"	3½"
Unit Weight	2 lbs.	5 lbs.

ULTRA COMPACT series

UTC Ultra Compact audio units are small and light in weight, ideally suited to remote amplifier and similar compact equipment. The frequency response is within 2 db. from 30 to 20,000 cycles. Hum balanced coil structure plus high conductivity die cast case provides good inductive shielding. Maximum operating level is +7db. Top and bottom mounting as well as circular terminal layout are used in this series as well as the ones described above.



A-10 Line to Grid
Multiple line to 50,000 ohm grid.

A-18 Plate to Two Grids
15,000 ohms to 80,000 ohms, primary and secondary both split.

A-20 Mixing Transformer
Multiple line to multiple line for mixing mikes, lines, etc.

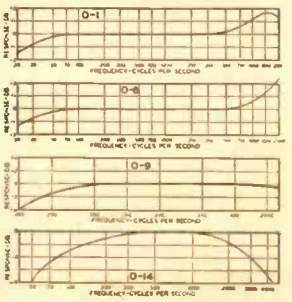
A-26 P.P. Plates to Line
30,000 ohms plate to plate, to multiple line.



A CASE	
Length	1½"
Width	1½"
Height	2"
Unit Weight	½ lb.

OUNCER series

UTC Ouncer units are ideal for portable, concealed service, and similar applications. These units are extremely compact . . . fully impregnated and sealed in a drawn housing. Most items provide frequency response within 1 db. from 30 to 20,000 cycles. Maximum operating level 0 db. These units are also available in our stock P series which provide plug-in base. The 0-16 is a new line to grid transformer using two heavy gauge hipermalloy shields for high hum shielding.



0-1 Line to Grid
Primary 50, 200/250, 500/600 ohms to 50,000 ohm grid.

0-6 Plate to Two Grids
15,000 ohms to 95,000 ohms C.T.

0-9 Plate (DC) to Line
Primary 15,000 ohms, Secondary 50, 200/250, 500/600.

0-14 50: 1 Line to Grid
Primary 200 ohms, Secondary .5 megohm for mike or line to grid.



OUNCER CASE	
Diameter	⅞"
Height	1-3/16"
Unit Weight	1 oz.

SPECIAL UNITS TO YOUR NEEDS

If you manufacture high fidelity gear, send your specifications for prices.

HFT

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