AUDIO

DECEMBER, 1962
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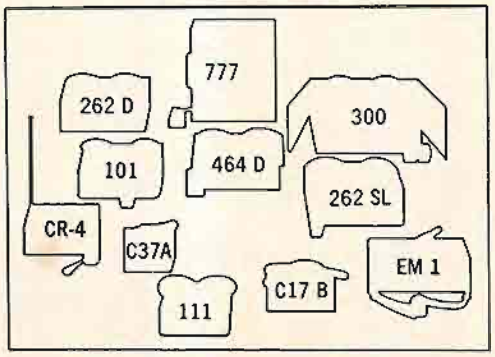

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SUPERSCOPE *The Tapeway to Stereo*

AUDIO

DECEMBER, 1962 Vol. 46, No. 12

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DAVID SASLAW · *Editor*

JANET M. DURGIN
Production Manager

HENRY A. SCHOBER
Business Manager

SANFORD L. CAHN
Advertising Director

EDGAR E. NEWMAN
Circulation Director

Representatives

Bill Pattis & Associates,
4761 West Touhy Ave., Lincolnwood 46, Ill.

James C. Galloway,
6535 Wilshire Blvd., Los Angeles 48, Calif.

Warren Birkenhead, Inc.,
No. 25, 2-chome, Shiba Hamamatsu-cho, Minato-ku, Tokyo, Japan

Contributing Editors

EDWARD TATNALL CANBY

JOSEPH GIOVANELLI

HAROLD LAWRENCE

CHARLES A. ROBERTSON

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Joseph Giovanelli

Send questions to:
Joseph Giovanelli
3420 Newkirk Ave.
Brooklyn 3, N. Y.
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Duplex High Fidelity Systems

Q. Over the years I have assembled a fine music system. My system includes the Marantz Model 7C preamplifier and the McIntosh Model 275 power amplifier. The power amplifier is remote from the preamplifier and is operated through a relay. My question is this. My old preamplifiers are McIntosh Model C8. The McIntosh amplifier is the only one that I own. Can a switching system be designed to allow me to use either the Marantz (in the main listen room) or the older preamps (in the recreation room) with the power amplifier? Please advise if this is practical. Robert J. Doknal, Lakewood, Ohio.

A. First of all, before contemplating the switching of either set of preamplifiers you should remember that you will also have to switch the amplifier from the set of speakers in one room to the set of speakers in the other room. This would have to be done in conjunction with the preamplifier switching.

The relay would have to be controlled from either of the two listening rooms, and this can be done by merely paralleling the switching which now actuates the relay with the switch located in the second listening room.

In order to switch the power amplifier from one preamplifier to the other, all you would have to do is to use a single-pole double-throw switch in such a way that it can switch the "hot" lead of the amplifier into either of the preamplifiers. (This, of course, supposes only one channel, or supposes a situation wherein the channels can be switched independently. If the channels are to be switched simultaneously, then you will require a double-pole double-throw switch.) To prevent feedback, keep this switch away from the one used for switching the speakers.

It would be desirable to have both switch elements actuated by a single shaft. If this is done, be sure that the decks are widely spaced and that a metal shield is placed between them. This metal shield should be grounded to your high fidelity system. In order to insert this shield, you must first disassemble the switch. Then mount the metal shield on each support rod in such a manner that the plate is sandwiched between the two spacers which are mounted on each rod.

As a precaution against high level transient "clicks" which could cause damage to your loudspeakers, do all this switching with the power amplifier turned off. The magnitude of these transients can be reduced by placing a 5-megohm resistor across the output of each channel in the preamplifier.

If all these precautions are followed you should have no trouble.

Pre-emphasis and the RIAA Curve

Q. I notice that FM pre-emphasis (75 μsec) coincides with the high-end boost called for in the RIAA recording curve.

In equalizing RIAA records for broadcast, can an FM station supply only the low-end boost, between 50 cps and 500 cps, allowing the high-end boost of the RIAA recording curve to serve as pre-emphasis?

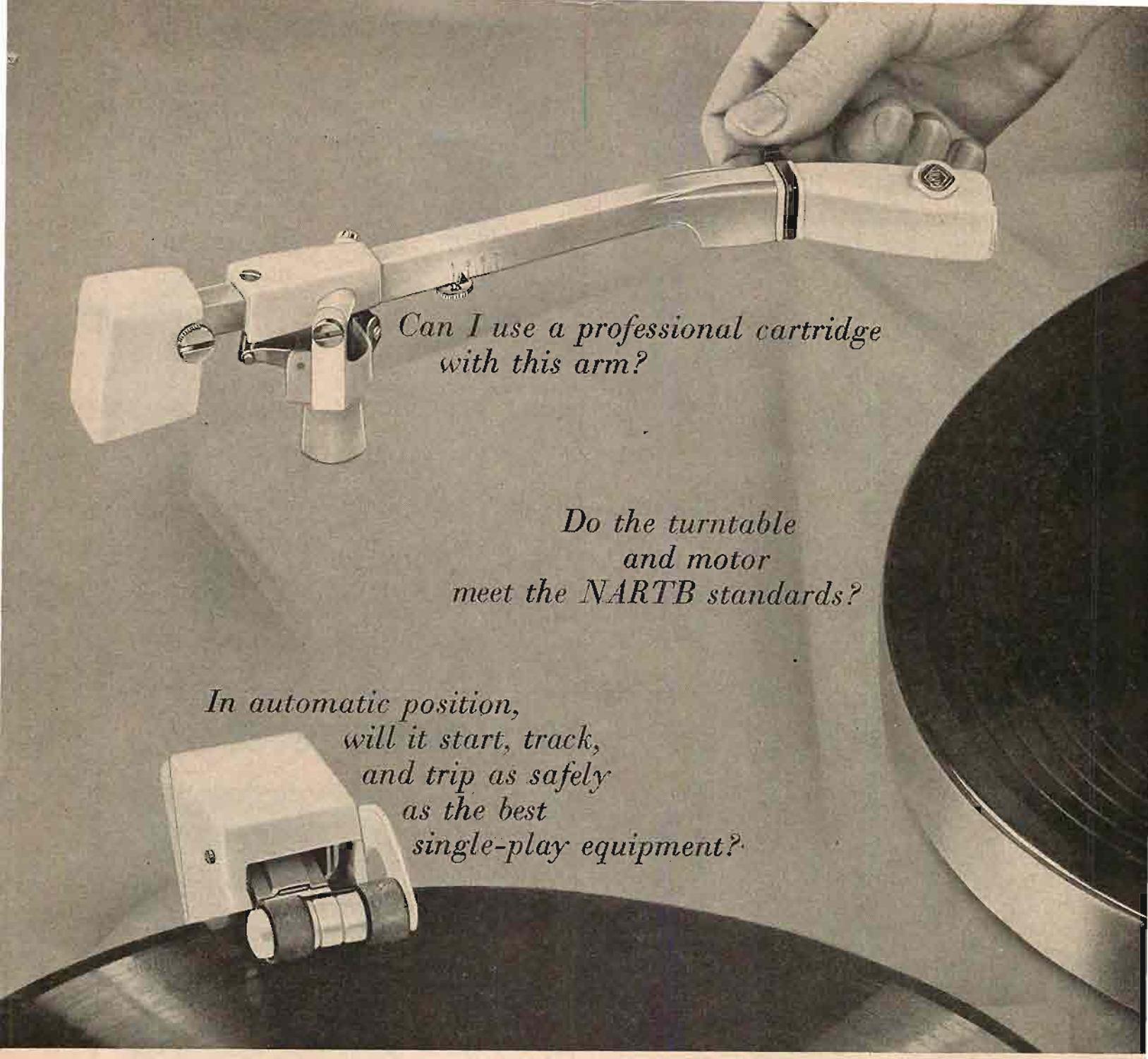
This would do away with the overlapping functions of high-end cut for RIAA playback and high-end boost for FM pre-emphasis, and it would justify the RIAA in choosing 2122 cps instead of the easier-to-work-with 2000 cps normally used for compensation computations. Roderick S. Oakley, Jr., LT. JG. FP., New York.

A. Theoretically an FM station could use the unattenuated high-frequency response of the RIAA disc to obtain the proper pre-emphasis, and the listener would hear the program properly. The one serious drawback to the scheme, however, is that the other program material would not conform to this standard. True, compensation could be introduced into the speech channels of the console, but this compensation would have to be added channel by channel. This is logical when you realize that if it were added to the output of the control console, it would be boosting all the time as is true in conventional practice, regardless of the setting of the record player—attenuated or unattenuated highs. If the record player were set to have a flat response at the high end, and if there were added boost at the output of the console, the result would be an exaggeration of the highs and overmodulation of the transmitter. Examination of a modern broadcast console will show that there is a considerable number of channels, and it would be a costly process to convert each channel in the manner required. In other words, just to remove the necessity of having high-end equalization of the record-playing channels, you would have to boost the response on all other channels, so more would be lost than gained. Although I understand what you are trying to do, I do not think that the dual equalization used today when records are being played over FM will cause any deterioration of the sound quality heard by the listeners.

When I refer to the channels of a broadcast console, I do not mean the term as applied to stereophonic sound reproduction. A channel might consist of a microphone input, phono input, tape input, or remote line input, all of these inputs feeding a common mixer buss in such a way that any or all of them can feed the common output connection.

Effects of a Load on Cartridge Damping

Q. I plan to build a transistor preamplifier for use with one of the new high-com-



THE ANSWER: *Absolutely Yes!*

These are some of the questions people ask their dealers when they learn, to their surprise, that the Garrard Type A Automatic Turntable costs only $79.50. Some have assumed this must be the price of the turntable alone... certainly not the complete unit. These are intelligent questions, since a few dollars do not really matter when you are investing hundreds in a high fidelity system, expecting to be able to enjoy music free of distortion, and to protect your substantial investment in records. ☐ Chances are, for example, that you may want to use one of the ultra-sensitive cartridges developed originally for separately-sold tone arms because of their high compliance. Now, Garrard has integrated precisely such an arm into the Type A. It is counterweighted and dynamically-balanced... will bring out the best in the cartridge of your choice... tracking at the lowest stylus force prescribed by the cartridge manufacturer. Best proof of its capabilities is that the Type A tone arm is on the recommended list of every important manufacturer of professional-type pickups. ☐ The Type A turntable and its double-shielded motor were designed for each other. The cast turntable itself is something special... full-size, heavy (6 lbs.), balanced and non-magnetic. You will hear no wow, no flutter, no vibration. ☐ Many people consider Garrard's pusher platform the most important exclusive Type A feature. This is unquestionably the gentlest device ever designed for its purpose, and gives you the incomparable convenience and pleasure of automatic play whenever you want it. ☐ With all this to offer, it is small wonder indeed that Garrard's Type A, in a single year, has become America's number one high fidelity record playing unit. It is proudly owned by a growing legion of discriminating people who, originally amazed at the price, have come to realize this superb instrument could have been expected only from the Garrard Laboratories.

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pliance stereo cartridges. I intend to obtain treble rolloff by loading the cartridge with a low value resistance. Will this adversely affect the compliance of the pickup in the way a meter shunt will damp a sensitive meter? Bob G. Mahrenholz, Tullahoma, Tennessee.

A. The stiffness of the stylus is much greater than the stiffness provided by a meter spring. Therefore, any damping which will result from the action of a loading resistor placed across the cartridge will be nominal as compared to the mechanical damping within the cartridge, and the added damping provided by the stylus being in contact with the record.

In addition, and possibly more important, the magnetic field of a magnetic cartridge is considerably less than that found in meter movements. The effect of this is to limit mutual coupling between the moving mass of the cartridge and its electrical circuit.

Voltage Across Volume Controls

Q. How do you measure the voltage at the volume control of an amplifier? My meter has a sensitivity of 20,000 ohms/volt d.c. The scale shows no indication at all. Would the indication—if I had gotten one—be 10-volt a.c. or d.c.? D. M. Anglin, Seattle, Washington.

A. If the resistance of our volume control is 500,000 ohms, and if the meter is set to the 10-volt range, the resistance offered by the meter is 200,000 ohms which is in parallel with the 500,000-ohm (or 0.5-megohm) volume control. This will automatically cause some voltage reduction because the total load resulting from the combination of the meter and the volume control is much smaller than the stage feeding this combination was supposed to see. Probably the voltage which appears across the volume control is only one volt, or even less. If the meter is switched to the one-volt range, the instrument will have a resistance of only 20,000 ohms. This will completely load down the volume control, giving you an intirely erroneous indication, if, indeed, you can get an indication at all.

You simply cannot use a meter of this type when reading high-impedance circuits: A VTVM is the only kind of instrument which can be used. The loading by a VTVM is very small because it has a resistance of perhaps 11 megohms, which is considerably more than the 500,000 ohms we have been considering.

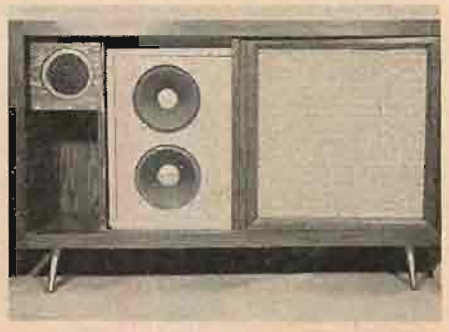
The voltage developed across most volume control circuits is an a.c. voltage, but this is not always the case. In radio receivers, for example, there is some d.c. along with the a.c. There is usually a capacitor which removes the d.c. component from the signal and allows only the a.c. to enter the audio section of the receiver. Æ

THIS MONTH'S COVER

This month we glimpse the system as assembled by James C. Valestin of St. Louis, Missouri. An interesting aspect of this audio center is that the cabinets were all designed and constructed by Mr. Valestin. Another unusually interesting fact is that the low-frequency speaker system is a CW folded horn built from plans presented in November, 1955, issue of AUDIO. Apparently some of those early designs still satisfy the critical audiofan. In building the cabinets, followed the unusual procedure of cementing ⅛-in. cork to ¾-in. plywood and then bonding walnut veneer on top of the cork. The thought behind the cork lining was to prevent resonances, and according to the builder, it is quite successful.

The equipment concealed behind those non-resonant panels is:

McIntosh C-20 preamp
(2) Dynakit 60-watt amps

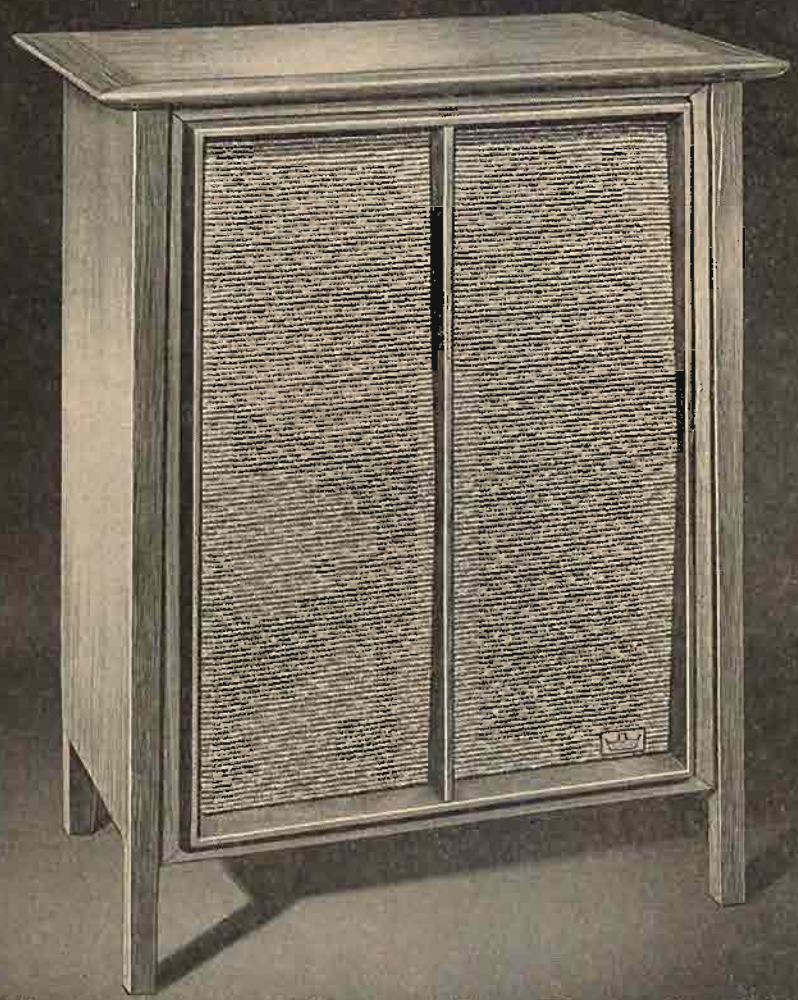


H. H. Scott 330B tuner
Thorens TD-124 turntable
Grado arm and cartridge
Ampex 960 tape recorder
(2) CW folded horns
(2) JBL 175 tweeters

A fan is built in below the C-20 and 330B to keep ambient temperatures low. The photographer of the system is Bill Sollis, an electronics instructor at O'Fallon Technical High School, and a photography enthusiast. Mr. Valestin asked us to especially commend his long suffering wife who put up with raw speaker enclosures, exposed components, wire leads, and all the difficulties of being an audiofan's wife.

If not for University's Classic Mark II...

this would be the finest speaker system of them all—



the new Classic Dual-12

the three-way system with two 12" speakers—plus!

From the first moment of its appearance, the Classic Mark II won instant and unanimous acclaim as the most exciting new instrument in the world of music reproduction. Its range, its presence, its spaciousness and dimension are truly outstanding, even when compared with the so-called "world's bests." Its reputation, however, posed this immediate challenge: Could University now create a speaker system with the essential qualities of the Mark II, but in a more compact size... and at a more moderate price? Could University now bring the pleasure of uncompromising big system high fidelity to a broader range of music lovers?

The challenge has been answered with the new Classic Dual-12, created by a totally new approach to the design of speaker systems. Instead of the conventional 3-speaker arrangement, University's Dual-12 incorporates two 12" speakers... plus the Sphericon Super Tweeter! One 12" speaker is a woofer specifically designed for optimum reproduction of the ultra-low frequencies (down to 25 cps); the other, a woofer/mid-range, reinforces the woofer, removes the peaks and valleys that cause harsh, strident sounds in ordinary systems and provides flawless mid-range performance. The renowned Sphericon is included to assure silky, transparent highs soaring effortlessly up to 40,000 cps! Power Requirements: 10 watts. Size: 23¾" x 31¼" x 15½". Oiled walnut finish. **$229.95** Hear it at your hi-fi dealer, or write: Desk R-12,

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LETTERS

Belt Slippage?

SIR:

Mr. Vilchur has been correct in many of his theories. However, this time he is really reaching. On page 38 of the October issue he states, "It may seem illogical that belt slippage will cause a turntable to run fast." It is illogical to use the ratio of diameters of the pulley and platen. If he had used the ratio of diameters at the neutral axis of the belt, he would have found that calculation of the pulley diameter with accuracy is very simple and does not require a theory of belt slippage.

We have no difficulty in calculating a pulley diameter which will give an accuracy of plus or minus one second in half an hour at a tape speed of 15 ips. Even this deviation from true speed can be explained in terms of variation of tape thickness, because the speed of the tape is determined, not by the capstan diameter, but by the diameter at the neutral axis of the tape. We can speed up the tape by using thicker tape or slow it down by using thinner tape on the same capstan. Thus it can be demonstrated that the diameter of a pulley or capstan is not the determining factor in establishing true speed. Accurate calculations must be based on the diameter at the neutral axis of the belt or tape.

L. S. SUBBER
Audiomation Laboratories
7230 Clinton Road
Upper Darby, Pa.

Tape Sync Standardization

SIR:

Mr. Hal Magargle's interesting contribution "Let's talk about tape synchronization (AUDIO, November, 1962) prompts some comment from this department. We do agree with Mr. Magargle that the high-frequency carrier method (14-kc sync signal) has disadvantages when used at low recording speed with portable equipment. However, it seems to us that he overestimates the head-contact and track-position difficulties of the three other systems described in the first part of his article. For our extensive location operations, we have selected the Pilot-Tone system for the following reasons: 1. The advantage of a biased control track recording is self-evident; 2. excellent portable recorders are commercially available with Pilot-Tone heads and associated circuitry already installed at the factories; 3. Pilot-Tone heads can be obtained at low cost from several manufacturers; they can be installed easily on location and transfer equipment; 4. a German DIN standard covering this system is also accepted in many other European countries and precise calibration tapes are available.

With hundreds of rolls of sync sound tapes recorded on eight different location units and reproduced on two transfer channels, not a single case came to our attention in which the synchronization was lost due to track placement or head contact difficulties. Recording and playback heads are pre-set with the calibration tape; no vernier adjustments are required. Pilot-Tone recordings from other Canadian or U. S. studios can be reproduced without changes of playback-head track position. Our recordings can also be reproduced without special handling in the foreign studios, provided they are recorded at approximately the same power frequency.

The National Film Board, an agency of the Federal Government of Canada, does not endorse products of specific manufacturers or support one particular method, but it seems to us that some standardization in this field would be to great advantage. We feel that the Pilot-Tone solution is very practical and quite suitable for motion picture dialogue recording. It should be considered seriously for international standardization.

We understand that the system advocated by Mr. Magargle has been in use for several years on a wide scale in the Russian film studios. As the Soviet Union utilizes the European power standard of 50 cps, the control frequency is 25 cps. Undoubtedly, playback synchronizers were installed in these studios, which are designed for this 25 cps system.

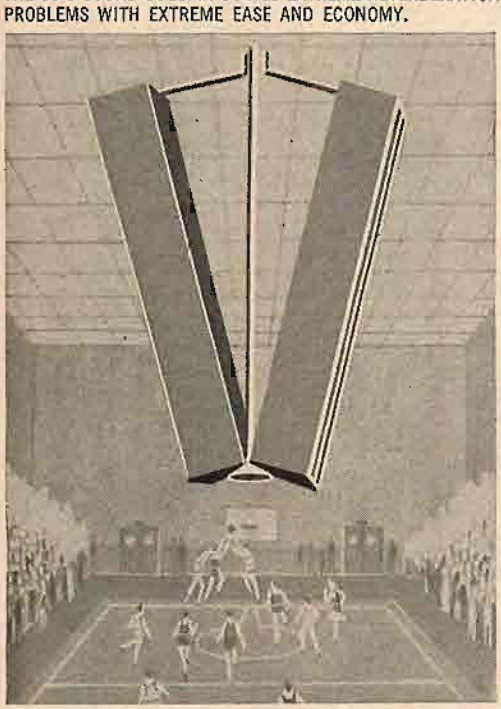
Your article does not state what equipment is available in the United States for the synchronous transfer of Mr. Magargle's 30-cps recordings to perforated film. A circuit diagram of his playback synchronizer would be of interest.

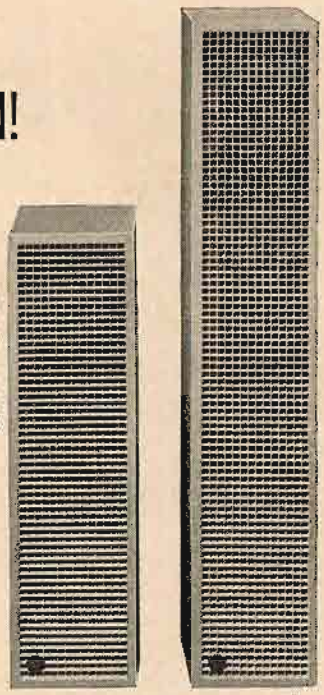
RUDOLPH ROLF EPSTEIN
Chief, Sound and Projection Div.
National Film Board
P. O. Box 6100
Montreal 3, Quebec, Canada

(*Continued on page 62*)

UNIVERSITY PROUDLY ANNOUNCES **ANOTHER** SOUND SOLUTION: THE UNILINE CS-3 SOUND COLUMN!

THE CS-3 SOUND COLUMN SOLVES EXTREME REVERBERATION PROBLEMS WITH EXTREME EASE AND ECONOMY.





MODEL CS-4
UNILINE
(Right)

MODEL UCS-6
UNILINE
(Far Right)

Here's the newest way to rid yourself of P.A. installation headaches in problem areas. Use the new University CS-3 Sound Column! It's specially designed to meet moderate power requirements—ALL AT A PRICE FAR LOWER THAN YOU'D EVER EXPECT FOR SUCH PERFORMANCE.

How? Easy—and with the same superb engineering and quality control that goes into all the Uniline products. With the CS-3 you get: ☐ superb speech reproduction in moderate-size areas; ☐ excellent music in high reverberation areas; ☐ extremely wide sound coverage; ☐ the complete answer to feedback difficulties. And, as with all Uniline Sound Columns, the CS-3 is ACOUSTICALLY TAPERED to prevent high frequency beaming...a University exclusive!

And don't forget another important characteristic of the CS-3: High 'A' (High Audibility), which is evidenced by a considerable decrease in distortion, improving intelligibility and increasing listener comfort. This is particularly noticeable when standing or sitting close to the sound source, for, as you know, conventional loudspeakers tend to 'blast' under similar circumstances.

So, for optimum dispersion (at all frequencies), for uniform sound levels (within the beam), for speech and music in high reverberation areas auditoriums, terminal waiting rooms, industrial areas, gyms, pools and churches)...FOR UNILINE SOUND QUALITY AT INCREASED SAVINGS...choose the CS-3, University's newest (and lowest-priced) addition to the Uniline Sound Column family. $89.95 dealer net.

DATA (compare the following specifications point for point with other products in the same class, then you decide which sound column will be your best, most trouble-free buy):

MODEL CS-3—(equipped with special elliptical hi-fi speakers and two tweeters for music and speech applications; tapered for use in clusters)

Frequency Range	150-10,000 cps
Power Capacity	25 watts
Impedance	16 ohms
Vertical Angle	22°
Horizontal Angle	120°
Dimensions	48" x 7½" x 8¾"
Shipping Weight	33 lbs.

For complete specifications and instructions on the entire Uniline Sound Column series, write: Desk R-12A, University Loudspeakers, White Plains, New York.

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Stereo Spectacular Demonstration and Sound Effects Audio Fidelity DFS 7013
Sound Effects (U.S. Air Force Firepower) Audio Fidelity DFS 7012

The Audio Fidelity command post moves up its heavy artillery in this pair of releases. In the Stereo Spectacular Demonstration album are to be found several intriguing morsels that are sure to preoccupy sound fans during the long winter nights ahead. About a third of the way through Side One of DFS 7013, even the mildly skeptical listener is apt to reach for his meter toward the end of a sweep of audio frequencies. The sweep gets under way conventionally enough from a starting point of 50 cps. As the sweep progresses upward in easy stages, no eyebrows will be raised during the trip up to 15,000 cps. Most mass-produced, regular-price test and demo records purport to go up to 15,000 and all of them manage to limp home at that point in one way or another. (CBS Laboratories STR-100 frequency-test record goes out to 20,000 cps, but that's a custom job selling for a firm $8.50.) As a rule, both the stereo cartridge and a fresh copy of a mass-produced test record will look healthier on a meter with some advance in gain beyond 12,000 cps. The assertion on this record that will do a fast job of eyebrow raising is the announcement heard at the end of the 15,000 tone. At the point where the average demo record is ready to call it quits, this stereo disc carries the announcement that you are about to hear a sweep from 15,000 to infinity. If you check this segment of the record on a meter (assuming, of course, that a stereo pickup of the latest generation is used), you will notice that the needle will climb back to the spot on the dial it occupied while you were taking a reading at 15,000 cps. After lingering a while in that position, the needle then fades away gradually, indicating that Audio Fidelity has enough on this disc above 15,000 to activate any up-to-date stereo cartridge. Just what manner of recording curve they employed above 15,000 will probably remain a closely guarded secret. Considered as harmless fun or the Real Thing, this sweep does point up the fact that four-track tapes have a long way to go before they can catch up to stereo discs in giving us the top of the frequency spectrum on a mass-produced basis. On DFS 7013, musical samples taken at random from earlier AF stereo records offer significantly better frequency range than we had in the original pressings. The sound effects heard here are some of the choicer bits found in Audio Fidelity's "Sound Effects, Vols. 1, 2 and 3" as well as its grimly mirthful "Cartoons in Sound."

The companion sound release is a comprehensive rundown on the firepower on aural display at the Air Proving Ground Center, Air Force Systems Command, Eglin Air Force Base, Florida. The sonic boom of an F-104 "Starfighter" sets the stage for a long parade of aircraft heard in various sounds of attack. The soft "plump" of napalm bombs is mixed with the hard crack of 500 pounders as they hit the ground not too far away from the stereo mikes. Automatic cannon, 30 and 50 caliber machine guns, even a gatling gun of the Spanish-American War try to unseat your cartridge. The 38 episodes in this potently realistic record offer almost unlimited opportunity for demonstration of motion in stereo with fresh challenges for all components in a sound system at almost every turn of the table.

Sounds Unheard Of Contemporary S-9006

This label deserves a vote of thanks from any progressive audio component dealer. Here, at last, is a demonstration stereo record capable of proving to a customer that there is a difference between the industry's very top line of components and those in the category just below. In all the important technical features that delineate a truly outstanding record, this release is tops. The unusually low distortion alone would be enough to set this disc apart. According to Contemporary Records, the special recording amplifier developed for this project will be made available to other labels. The two dozen instruments of exotic percussion are played by Shelley Manne and Jack Marshall. Disdaining the elaborate trickery used by some labels these days, Contemporary went directly to master tape at this session. They have a great record with which to prove the wisdom of their way.

Oliver (Original Broadway Cast) RCA Victor LSOD 2004

Is there a race in progress among theatrical producers to see who can find the unlikeliest story for a new musical? The adventures and misadventures of Oliver Twist form the basis of this musical which Lionel Bart derived from the famous novel by Charles Dickens. The idea of a race for unlikely material suggests itself because Bart, who did the book, music and lyrics of "Oliver," is already working on a musical adaptation of "The Hunchback of Notre Dame." I reckon I'm as broad-minded in these matters as the next man interested in the theater but I find it difficult to imagine the grotesque figure made famous to two generations of moviegoers by Lon Chaney and Charles Laughton actually bursting into song as he swings about the facade of Notre Dame. Or will the producers merely ask him to grunt in time with the music? If one speculates on these possibilities, the characters of Dickens begin to seem less out of place on a musical stage.

"Oliver" represents England's answer to the long stream of American musicals that have been successful on both sides of the Atlantic. It has been a source of some annoyance to British theatergoers that so many of the musicals that have played London in recent years have been imports from America. Taking a leaf from our own great musicals such as Oklahoma and Carousel, Lionel Bart decided to draw upon local color for the setting of this show. On the premise that nothing could be more British than the England of Dickens' day, the producers assembled a fine cast of London-trained actors to recoup the fortunes of their own musical theater. It's still too early to tell how Broadway will react to "Oliver" because this original cast album has been released some three months before the New York opening of the show. My own guess is that some theatergoers will find the early scenes in the boy's workhouse rather depressing but things should get more interesting on stage as soon as Dickens' famous characters, Bill Sikes and Fagin, enter Oliver's life. Certainly the show appears pretty static on records until Fagin, in the person of Clive Revill, advises his boys that *You've Got to Pick a Pocket or Two.*" This show makes little effort to follow the usual pattern of a musical; the only number that even approaches a conventional romantic ballad is *As Long As He Needs Me* sung by Bill Sikes' girl, Nancy. Georgia Brown, as Nancy, has been with the show since it first opened in London June 30, 1960. She fills the only major female role with graceful assurance. Bruce Prochnik was a logical choice for the part of Oliver, having played the title role in a thirteen-part serial of the straight version of "Oliver Twist" on British television. The songs from "Oliver" won't dislodge many favorites on the Hit Parade but they are serviceable enough in conveying the atmosphere of the Dickens' novel. David Merrick, by far the busiest producer on Broadway in recent years, has displayed great faith in "Oliver" by lining up a five-month pre-Broadway tour that is taking the show to such out-of-the-way tryout cities as Los Angeles, San Francisco, Detroit and Toronto. RCA Victor's Hollywood studios were selected to play host to the original cast in this recording. The sound on the disc, while adequate, is not as bright as the label's East Coast show recordings.

Carousel Command RS 843 SD

When the ad campaign for this record first appeared in print some months ago, several new peaks were hit in the coining of phrases of self-praise. Any new recording of a good Broadway musical arouses some degree of interest in this corner but this release piqued more than average curiosity because it didn't hesitate to bill itself as something super-special. This was to be the first venture in which Enoch Light was to apply the flashy techniques of Command's Persuasive Percussion and Stereo 35 MM to a standard production of the musical stage. Not only was the sound to be different in this new production of Rodgers and Hammerstein's "Carousel," the show on this record was to feature—and we quote—"an unparalleled cast in which each song was recorded by its greatest contemporary interpreter—Alfred Drake, Roberta Peters, Claramae Turner, Lee Venora, Norman Treigle and Jon Crain." The first-named are certainly top-drawer artists and I looked forward with considerable interest to see what they would do with the leading roles of this story of the New England fishing coast of bygone days. After all that anticipation, it is depressing to report that the weak point of this album lies in the nature of the performance handed in by the entire cast. Many listeners have felt that the Carousel score is one of those rare documents of the theater that towers over its fellows no matter who performs it. After listening to this record, I'm not so sure. For the first time, Carousel sounds almost humdrum on records. It's not the fault of the recording engineers. The singers simply seem to have had all the spirit drained out of them by the time each song went through its final "take." Consider the situation facing this cast. To the casual observer, the man in charge of the recording session was the veteran musical director, Jay Blackton, who had guided on Broadway such great shows as "Oklahoma," "Annie Get Your Gun" and "Call Me Madam." There is every reason to suppose that the first few run throughs of each song had some life in them. Unfortunately for the listener expecting a normal amount of spontaneity in a show album, matters were not allowed to rest in the completely capable hands of Mr. Blackton. Stationed in the control room during the four arduous sessions that stretched over a period of two weeks was Command's president and final authority on reproduced sound—Enoch Light. In his first full recreation of a Broadway show, Mr. Light has chosen to carry forward the formula of his well-known instrumental recordings: almost endless repetition of a phrase until he was satisfied that maximum effect had been achieved. While his "Carousel" cast may not have been called upon to re-record an item 39 times (the total claimed for "takes" of one tune in the first Command disc), Alfred Drake was asked to record one ninety-second "Carousel" song almost continuously for 30 minutes. Throughout this disc, every "j" has been dotted to a "t" but the flavor and fervor of a great American classic is only suggested.

Billy Bigelow, the hero of the play, emerges as a far more mature individual in Alfred Drake's characterization than he did in previous recordings. This is hardly a disadvantage in the musing *Soliloquy* but there are

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plenty of other occasions when John Raitt (the Original Cast Decca album) and Gordon MacRae (the movie soundtrack on Capitol) better realize the very essential youthful boastfulness that's the keystone of the character the composer and lyricist had in mind. The rest of the cast, along with Drake, works very hard but the characters never really come to life. The studio accoustics in which they perform add very little in the way of stage illusion. Put this one down as an elaborate try by two many cooks.

Christmas with Rita Ford's Music Boxes Epic BN 26022

An unbeatable combination at Christmastime is a music box heard on a good, up-to-date recording. Stereo isn't a vital factor in this Epic release because a single box cannot sound much better than it would on a mono record played through a stereo system. The important difference in this music box release lies in the fact that it was processed in the plant of a major label. As some listeners have discovered to their sorrow, not all music box records issued in the past have received adequate pressing. The collection on display at Rita Ford's shop in New York City happens to be the only group of music boxes currently available in stereo.

Andre Kostelanetz: Star Spangled Marches Columbia Stereo Tape CQ 470
Hail Sousa! (University of Michigan Band) Vanguard Stereo Tape VTC 1650

How do you like your marches these days? Between them, these two recent reels should take care of just about any whim entertained by those seeking fresh band material for the tape section of their sound system. The preponderance of novel effects is to be found in the Kostelanetz tape with its deliberate manipulation of directional stereo attack. The Columbia reel enjoys a specific advantage in bedazzling the listener because the program does not confine itself to the output of one composer. Some of the glittering products of the theater (*Strike Up the Band and Seventy Six Trombones*) rub elbows with Colonel Bogey and *American Patrol*. If you like a lot of alternating action in your channels as part of a hopped up band arrangement, Kosty has the field pretty much to himself in this release.

If, on the other hand, you're looking for a traditional approach, a more conservative flair in your band music, I think you'll find the Vanguard reel a tonic experience long after the novelty of the Kostelanetz recording has worn off. The University of Michigan band, 100-men strong, is just the outfit to put new meat on the sturdy bones of the more famous Sousa marches. In his direction of the band, Dr. William D. Revelli has been able to work out a firm yet outwardly light-hearted discipline; the ebullience of youth makes the difference in the beat of this seasoned organization. Sousa's association with the University of Michigan is underlined in the choice of the march, *Northern Pines*, written by Sousa to salute the University's summer camp.

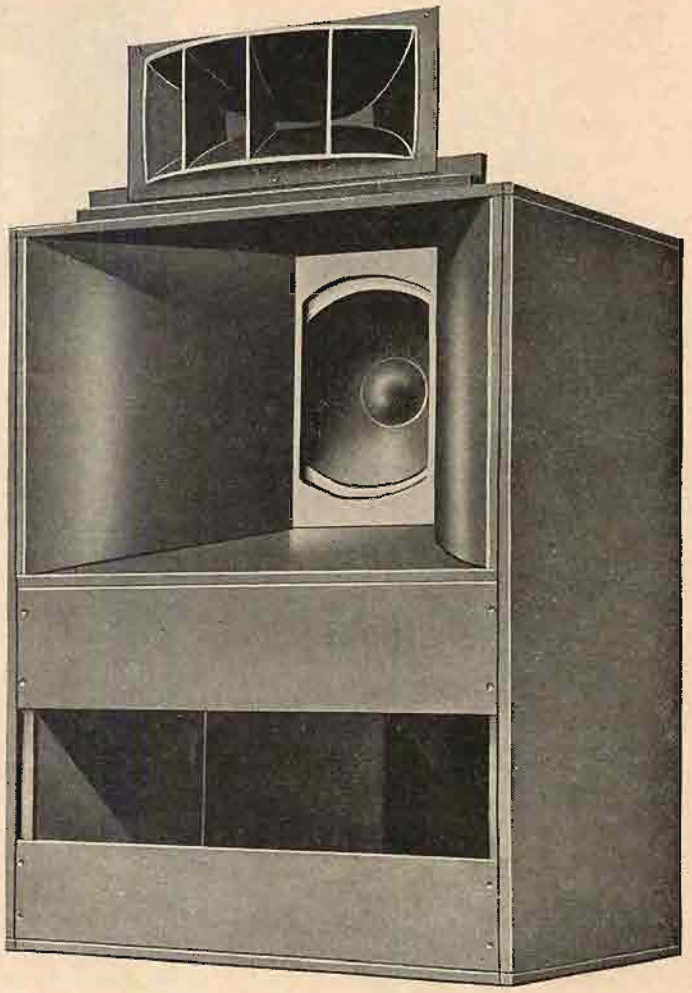
Enoch Light and Orch Play Irving Berlin Command RS 840 SD
Melachrino Strings: The Waltzes of Irving Berlin RCA Victor LSP 2561

Here are two contrasting approaches to the music of Irving Berlin who is returning to the Broadway limelight this season with his new show, "Mr. President." The Command disc is a virtuoso job of recording that squeezes every last ounce of showmanship out of the old Berlin tunes. . . . RCA's Melachrino album is content to settle for the orthodox virtues of the Berlin waltzes. The engineering crew working with the sixty-man orchestra Enoch Light assembled on the stage of Carnegie Hall really turns in an amazing job here. It seems that each session held by Command in this hall in recent months has shown specific improvement in the dynamic range aof the finished record. The sensational dynamic effects achieved here had their start, of course, in the special arrangements cunningly worked out by Lew Davies. He hasn't missed a trick in converting some of the brighter Berlin tunes into spine-tingling productions. The brass sec-

(*Continued on page 69*)

THIS IS NO COMPACT!

54 inches high
9 feet around the middle



That's a lot of speaker system. Enough for what pleases you. It can whisper or it can bellow. It does both superbly, and anything in between. So much so that Hollywood's famous United Recording Corp. (sound studio for record, tape, film, and tv industries) employs 15 of them. As does Ray Heindorf, musical director of Warner Bros.' production "The Music Man" and holder of 2 Oscars, who has four right in his living room.

No, this is definitely not a compact. It's a giant, this A-7 "Voice of the Theatre" by Altec. A full-size speaker system with quality to match. That's why it belongs in your home. Unless you are willing to settle for a compact "book shelf" speaker... and compact sound. Of course if you are a critical listener, you'll want your sound brought to life by Altec; sound so realistically reproduced, you'll find its equal only in the concert hall.

That much the A-7 will give you, and more. Almost in direct proportion to your own desire for perfection. If you insist on hearing the "full sound," the most subtle contribution of each instrument, the effortless reproduction of massive orchestrations at concert-hall listening levels, then the A-7 is for you.

Now here is a hint: you can't make it any smaller, but you can make it a lot prettier. All it takes is a bit of effort, some grille cloth, some veneer or paint and you can transform the A-7 into a custom furniture piece. For built-in installation, there's nothing so perfect. At only $285.00 each, it's a wonderful do-it-yourself project... for the critical listener.

However, if you prefer your A-7 sound coming from a more civilized version, we have several solutions, in walnut or mahogany. There's the 831A "Capistrano," a full-size beauty that offers speaker components identical to the A-7 in a classically styled cabinet. It stands 30" high, 47" wide, and is priced at $399.00.

The modern 838A "Carmel" is also a full-size, floor-standing system. It features two 12" low frequency speakers (instead of the one 15-incher in the A-7) and the same high frequency section. It's priced at $324.00 with decorator base (shown) extra; standard model comes with round legs. The "Carmel" is also available with one low frequency speaker in a model called the 837A "Avalon," priced at $261.00.

ALTEC 838A "CARMEL"

ALTEC 831A "CAPISTRANO"

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Apartment-size version of the full-size Altec speaker systems, the "Coronado" is styled to match a pair of "Carmels" when used as the center speaker in an Altec 3-channel stereo system. Recommended for small apartments where space will not tolerate larger speakers. The "Coronado" is 30" H, 18" W, 14" D and is priced at $199.50.

Go ahead, convince yourself! The A-7 (and its prettier mates) are ready to tantalize you now, at your Altec Distributor's. Or, for latest stereo catalog, write Dept. A-12.

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AUDIO ETC.

Edward Tatnall Canby

STEREO FOR TV?

Press release from GE, says that the big company is proposing a TV stereo sound transmission system to the FCC. GE's pilot work on this idea, it says, is intended to lead: A, To a compatible TV stereo arrangement; B, a system that would be inexpensive in the receiving equipment and so put TV stereo "within reach of the entire public"; and C, similarly, a system that would not be too expensive for the average TV station to install. (In TV terms that means, let's guess, not over a half million bucks or so . . .) Worthy and interesting objectives on GE's part and much of the spade work is evidently already done. Just have to persuade the FCC. And maybe, as an afterthought, me.

No dispute with the GE technical objectives. Hardly, always assuming that technical transmission standards, as in the case of stereo FM radio, aren't too far compromised. (Some people think our present FM multiplex system is dismally compromised—but it isn't a tenth as compromised as some of the systems initially proposed.) Clearly, we are all of us likely to be pro-economy and, most likely, pro-compatibility as well. Receive the stereo signal, as in radio, via a mono TV tuner.

I am slightly confused, I'll admit, as to whether a wholly separate and possibly quite different technical set-up is in the works for TV stereo sound and its separate FM channels. If you'd asked me awhile back, I would have assumed that the present multiplexing system would merely be extended to cover the TV sound bands. On the other hand—is there a similar "storecast" problem in the TV sound area—that is, the need for an additional multiplex channel or two, not receivable on home equipment? If no such need arises, then perhaps a simpler (and less expensive) multiplexing system could be instituted for TV, straight from the beginning. In actual practice, as we are now set up, there is little prospect of any overlap between FM-radio and FM-TV sounds. Different bands but, more important, a different home-equipment approach, one system operating on the old continuous-tuning band, the other on fixed switched numbered channels, unidentified as to frequency location. Unless our entire broadcast system is tossed into a huge melting pot, the FM-radio and FM-TV sound transmissions are going to continue in effect almost totally separated.

Separate, too, of course, in standards of audio quality, unofficially if not otherwise. The average TV sound-tuner isn't exactly a superb piece of audio equipment. The average home-type FM tuning section, in FM-AM pocket radios, table models, portables, isn't very superb either—but on the other hand, we do have in the hi-fi component equipment area, and in a considerable overlapping expanse of higher-priced console AM-FM equipment, a decidedly lofty standard for home FM quality. Not so in TV. Well, not in *most* TV sets, anyhow. There's no need for it.

The Audio-visual Blend

No need for high quality in TV sound? That's what I said.

Strangely enough, I have felt for a long time that TV sound is precisely what it should be for best blending into the TV video picture.

The purpose of the TV set is to bring home to you a unity of sound and sight. As anyone can understand, this involves a maximum of apparent or effective compatibility between the two basic elements, in every respect, that directly involves the listener-viewer. Like hi-fi music, TV produces a tricky and highly exact *illusion*. It does not reproduce the "live" material literally.

In order to achieve this effective compatibility, we've developed a raft of extremely ingenious techniques for TV. Take mike technique versus camera technique. Wouldn't it be dandy if you could mount your mikes on the camera housing and just forget them, with instant compatibility at all times? Nice idea, but it doesn't work. In order to have sound and sight that *seem* to be one, we must use wholly different techniques for the two. Neither technique is "natural." Video lighting and placement are highly specialized, as anybody who has stared at a TV camera knows. TV sound is even more specialized than broadcast and recorded sound since its "ears" must be all over the place yet, as far as possible, must remain unseen. Take these two "unnatural" techniques, for sight and for sound, figure out a complex and very tricky relationship between them—and you have our masterful television transmission, a remarkably effective blending of the two.

Therefore note this well. Any undue incompatibility between sight and sound that is perceivable by the TV viewer is going to make trouble, but quick.

Our TV picture, though very effective, is not technically "hi fi." With its present number of lines (exceeded in European systems) it achieves only a fair sharpness. Doesn't matter how good your set is, nor how large the screen, of course. The maximum sharpness is a fixed limitation. I would rate it, aesthetically, as roughly equal to a "clean" standard AM broadcast sound-reception, as heard on moderately good AM equipment. (Discounting static, and discounting TV interference, ghosts, and such.) Your TV picture is clearly not the equal of a sharply reproduced slick-paper magazine photograph in terms of plain "fi." Nor of the even sharper original photo print, at its potential best.

Therefore, it seems to me, present TV sound reception, via so-so tuner equipment and definitely so-so speakers, *is* highly compatible, matching the picture quality itself. Unless the picture is dramatically sharpened and, perhaps, greatly enlarged as well, our present grade of TV sound is *the best* for a proper blend between sight and sound.

I am highly skeptical of "hi fi" TV sound, reproduced flawlessly through expensive audio equipment, including speakers. Destroys the blend, breaks the fusion between the two elements, by sheer difference in respective "fi"—quite aside from an even worse difficulty, the spatial discontinuity.

At least, your present TV sound seems to come from the screen. You don't even think about it, of course, and for a good reason. You don't have to. The illusion of identity, sound-and-sight, is extremely well produced. But via "big" hi-fi speakers your sound suddenly is huge, loud, wide, broad, tall, space-filling. And the TV picture? Suddenly, you have a fuzzy little thing by comparison, lost within its extremely narrow angular dimension. Not good at all. Incompatibility between big sound and small picture, between sharp, wide-range sound and soft, unsharp picture, defeats the entire purpose of the over-all TV transmission, doesn't it?

And Over on the Left . . .

How about stereo sound for TV? I think you can see the problem. It is simple enough, in terms of plain effectiveness. Will stereo sound in TV add new incompatibilities, to the detriment rather than the improvement of the TV blend?

What else? The most glaring incompatibility, blithely ignored by those who are promoting the wonders of stereo sight-and-sound, is that of sheer dimension. Ah, how lovely to hear the great Philadelphia Orchestra, they say, in the glory of true stereo sound. . . . The violins play away over there on the left, and—lo and behold—you can actually see them, playing on the left!

Oh yeah? I can just see it myself, and so can you. Beauteous hi-fi component installation. Left speaker, say off over there at an angle, on one side of the room, right speaker on the other side of you, the two making perhaps a 60- to 90-degree angle. And spang in the middle, in front, the TV set. What a spread! Left side of the picture almost five degrees from the right.

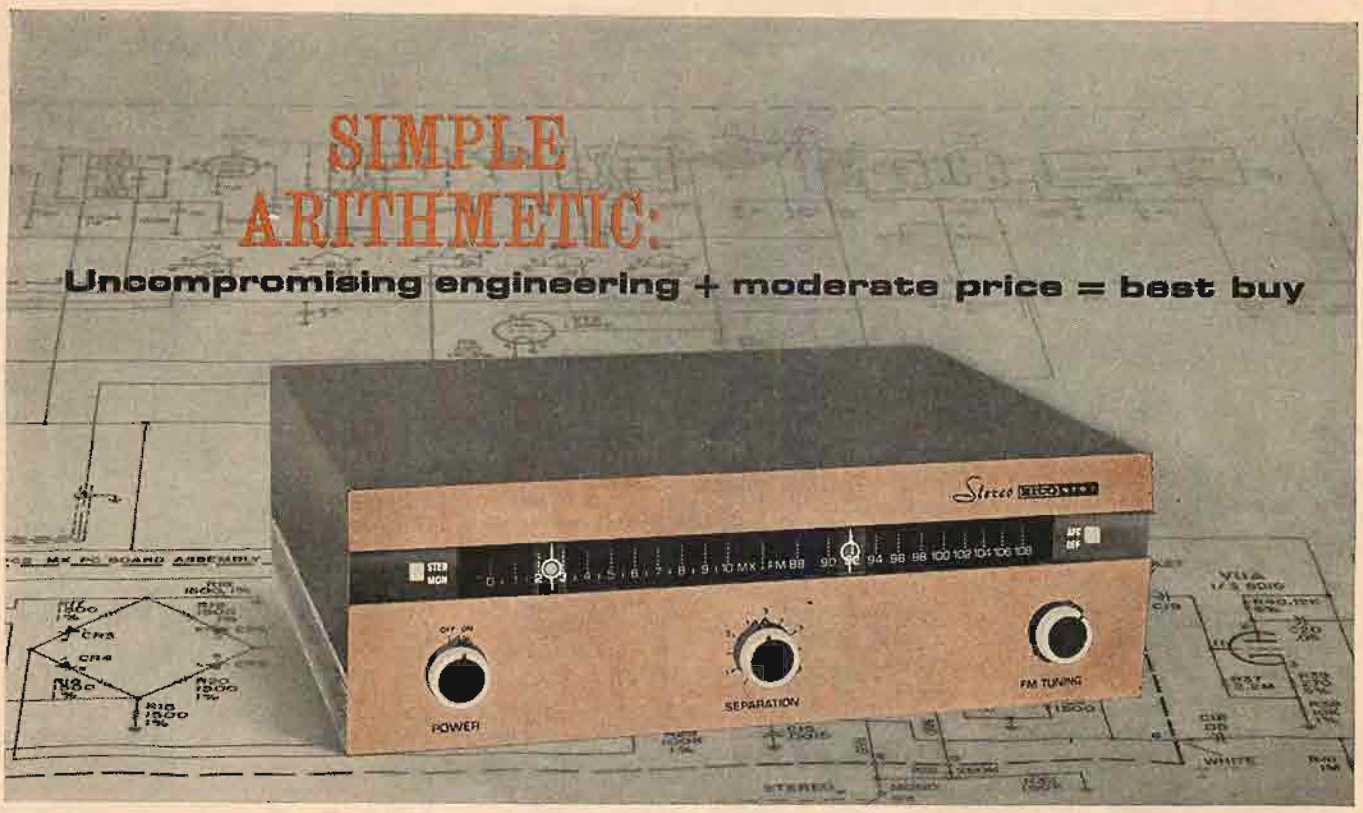
Most amusing. Your audible Philadelphia Orchestra appears to occupy the whole side of your living room, out to and beyond your hi fi speakers; the "virtual" image, taking into account the apparent audible distance, is much larger, somewhere off in the mystical stereo-space we know how to create so effectively. And the visible accompanying image is at best something over a foot wide.

Where, I ask, is the compatibility? What are you supposed to do about blending that huge, sharply audible violin section way over to your left and that tiny, inches-wide miniature violin section somewhat fuzzily visible straight ahead? More than I can figure out. And the hi-er the audio fi, the worse it will be, natch.

* * *

Well, I do see a hidden compatibility. You won't think me cynical if I mention it here, since we all are aware of it. The answer to TV stereo sound is ultra-simple. *Just bring the speakers close together.* Compress the stereo to TV size. (And, while you're at it, limit the stereo audio quality to a suitable level of fi, more or less like that prevailing right now for TV.)

This, you see, is highly commercial and extremely practical. Morever, it will produce—quite seriously—the best possible



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THE CIRCUIT

the front end Consistent and reliable printed circuit. Ultra-sensitive, stable, and low-noise. Wide-band design. Rugged plated steel housing for protection and shielding. Meets FCC radiation requirements. Precise temperature-compensation for freedom from drift without AFC. AFC provided with defeat for convenience. Indirect gear drive is backlash-free and eliminates possibility of microphony.

the IF strip Four IF amplifier-limiter stages (all that will do any good) and an ultra-wide-band ratio detector, all pre-wired and pre-aligned. Designed with the utmost practicality so that the simplest alignment is also the alignment for highest sensitivity and practically lowest distortion. (Important to you if a service alignment is ever required.) Output is flat to the limit of the composite stereo signal frequency spectrum to eliminate any need for roll-off compensation in the stereo demodulator.

the stereo demodulator Ten stages for unequalled performance capabilities. EICO's brilliantly-engineered zero phase-shift, filterless detection circuit (patents pending) eliminates loss of separation due to phase-shift in the stereo sub-channel before recovery. Complete rejection of storecasting interference. Cathode follower driven, sharp cut-off 15kc low pass filters in each output channel.

THE OPERATION

Two slide-rule dials in a line: one, a station frequency dial with the famous EICO "eye-tronic"® tuning-eye travelling along it to indicate the exact center of each broadcast channel; the other a logging dial with an automatic stereo indicator lamp travelling along it in tandem with the tuning-eye to indicate when the station tuned in is broadcasting stereo.

THE LOOK

Massive extruded aluminum panel and side rails, exquisitely brushed and anodized pale gold, with baked epoxy brown, perforated steel cover.

PERFORMANCE

Pre-production field tests brought back the report "Definitely a fringe-area stereo tuner," which is simply the meaning of our laboratory measurements. We know, for example, that full limiting is achieved at 10uV input signal, meaning that the low distortion and noise specifications (the full benefits of FM) will apply to all but the most distant and difficult-to-receive stations. The sharp selectivity you need when a tuner is that sensitive is here also (a strong local station and a low-power station 100 miles distant separated by only 0.4 mc, each had its own sharp tuning-in point on the dial). While signal levels as low as 2.5uV will produce phase-locking for full stereo separation, very strong local signals will produce no higher output from the FM detector than a 10uV signal and will not be degraded in quality by overloading the stereo demodulator. Distortion is very low, both in mono and stereo, so that the sound you hear has that sweetness, clarity, and freedom from grating harshness that results from absence of distortion. The stereo output signals are so clean that there is not a sign of the 19kc pilot carrier or the re-inserted 38kc sub-carrier visible on a scope presentation.

SPECIFICATIONS

Antenna Input: 300 ohms balanced. IHFM Usable Sensitivity: 3uV (30db quieting), 1.5uV for 20db quieting. Sensitivity for phase-locking (synchronization) in stereo: 2.5 uV. Full limiting sensitivity: 10uV. IF Bandwidth: 280kc at 6db points. Ratio Detector Bandwidth: 1 megacycle peak-to-peak separation. Audio Bandwidth at FM Detector: Flat to 53kc discounting pre-emphasis. IHFM Signal-to-Noise Ratio: —55db. IHFM Harmonic Distortion: 0.6%. Stereo Harmonic Distortion: less than 1.5%*. IHFM IM Distortion: 0.1%. Output Audio Frequency Response: ±1db 20cps-15kc. IHFM Capture Ratio: 3db. Channel Separation: 30db. Audio Output: 0.8 volt. Output Impedance: low impedance cathode followers. Controls: Power, Separation, FM Tuning, Stereo-Mono, AFC-Defeat. Tubes: 1-ECC85, 5-6AU6, 1-6AL5, 1-12AT7, 2-12AU7, 1-6D10 (triple triode), 1-DM70 (tuning-eye), 1-EZ80 rectifier, 6 signal diodes, 1 neon lamp. Power Source: 117V, 60cps; 60 watts drain; extractor post fuse. Size (HWD): 5⅛" x 15⅞" x 11⅜". Weight 17 lbs.

*Actual distortion meter reading of derived left or right channel output with a stereo FM signal fed to the antenna input terminals.

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fusion of the audio and video elements in the TV fusion. Deny me if you dare.

I'm even willing to admit that, given a pair of stereo speakers—little ones, placed a foot or two apart—there could be a real improvement in TV sound definition and a distinct fusion between right and left elements in the sound and in the sight. Indeed, it would seem likely, don't you think? My thought is that this is the hard-core, practical future of stereo sound on TV, realistically. That is, until we have wall-to-wall TV in ultra-sharp definition.

'Course we can't talk about it in these terms—dear me no. Can you imagine a TV ad that would claim lo-fi as better than hi-fi? And so, as is now already happening, we'll have the usual high-wide-and-handsome language, the big ballyhoo about the Philadelphia Orchestra (and maybe Jack Paar too) right in your living room. Also the Piel Brothers, in Animated Stereo. So, I suggest, put all this in the back of your mind and don't forget it. Don't forget for an instant that *lo-fi* TV stereo sound is the only transmission that holds real promise for genuine TV improvement via twin-channel audio.

SPACE PERSPECTIVE

This is a commercial follow-up on the "Bauer circuit" for earphones discussed at various times in this department—the cross-feed, phase-shift circuit that simulates for the ears the effect of stereo loudspeakers, each ear (in its phone) hearing elements of both channels, re-phased to give two opponent right-and-left sources. Some months ago, Jensen took a license on the circuit and set out to develop a couple of phone boxes for the earphone trade in which it would be incorporated. One box is the basic circuit itself, economical, unadorned. The other is a more complete control unit, the Jensen CC-1 Stereo Center. Stereo center for speakers and earphones. I've just tried it out and hasten to report. For once, this really is *stereo*, via phones. Jensen calls it "Space Perspective."

It works, this commercial version of the Bauer circuit, and it works beautifully. Better than I would have thought likely, somehow. (I turn cynic, between fits of optimism.) I had not tried the circuit at so much leisure in home circumstances before; now, I see that there are subtle but real fringe benefits to be had from the improvement in the parcel of sound information that goes to the ears.

An old principle in my experience is that any improvement which tends to satisfy the ear's natural sound-needs in one area provokes the *illusion* of greater "fi" in other areas, and vice versa. A good speaker in a poor location often seems to distort—so realistically, that many a person has torn hair in vain looking for an electrical cause. The same speaker in a fine listening spot may sound superb. Indeed, a relatively punk speaker can fool you into thinking it is pretty good, given the right listening place. Similarly, good recording acoustics, good mike pickup, can make a recording sound better than it is, covering up so-so technical quality. A poor mike pickup, on the other hand, can make you swear you hear distortion, though you can't pin it down. Carefully trained ears, of course, can discriminate between these natural illusions and real distortion —or real quality—but the principle is always there, just the same.

"Stereo" via earphones is, varyingly (according to the type of mike pickup), a serious natural distortion of the musical effect. There is a (varyingly) severe lack of correspondence and fusion between elements in the two channels. This leads to listening fatigue, like so much eyestrain; a careful listener notes unpleasant disparities and discrepancies in the space perception, a sort of "ringing" two-ness to the sound, instead of a two-eared one-ness with spatial dimension. The more mikes in the recording, the further they are separated, the worse is the aural confusion via phones.

That much is a restatement of a point I've made before. It should be restated, because we still find it commercially profitable to deny the whole thing—to say that stereo via phones is marvellous, or "better" than stereo via loudspeakers.

For a few moments—yes. The impact is extreme. It soon fatigues. But when the phone circuits are treated to simulate the ear's natural reception of loudspeaker stereo, we get not only a more realistic approximation of stereo sound but, oddly, a cleaner sound, less "distorted." There is no actual difference, of course. Same signals, same amplifiers. (The cross-feed actually clutters up the two signals with new elements of complexity.) This was the first thing I noticed when I began systematically to switch Jensen's CC-1 Space Center between REG (straight two-channel) and SPACE PERSPECTIVE (the Bauer circuit). On Space Perspective, the sound was noticeably clearer, crisper, less edgy, more comfortable. An interesting illusion.

Gray Noise

Moreover, in addition, the background noise, general hiss-rumble, was in many cases noticeably reduced in the Space Perspective position. Is that an illusion? If so, it's a very useful one. (Oppositely, the illusion of edgy musical distortion, on straight two-channel, is undesirable any way you look at it.)

This background noise reduction has me bemused. I know that a normal phenomenon when we are subjected to two separate and simultaneous gray-noise signals is that the noise level seems much higher than it ought to be.

We often experience this on large loudspeaker systems with wide separation, as in demonstration halls, ball rooms, and the like. Many an engineer will testify to it! Two channelsful of gray noise seem at least five times as objectionable as one. It is the lack of blend that does it, of course. Your ears can't bring the two into any sort of "focus," can't fuse the two sounds—and so they react violently by bringing the noise into the forefront of your consciousness. It's an unmistakeable effect.

Without a doubt, stereo heard via straight two-channel phones exaggerates recorded noise content on this very principle. It should be logical, then, to expect the Bauer circuit's cross-feed feature to reduce the *apparent* noise level. But there are complications. In this case there is a synthetic phase difference introduced by the circuit.

Perhaps (I'm theorizing), it is possible for the ear to "fuse" the noise signals, same noise but sent to the two ears slightly removed in phase, for a right and a left noise location corresponding to that of the musical signals. Instead of hearing two unrelated gray-noise sounds, one exclusively in each ear, we hear two apparent gray-noise *sources*, in simulated space.

I suggest that this in itself is enough to partially "satisfy" the ears and allow them, consequently, to push the noise towards the background levels of consciousness. We should never underestimate the tricks that ears can play on "factual" signals. After all, aren't there dozens of noises, like refrigerators, air conditioners,

(*Continued on page 73*)

NEW PRODUCTS!

High-performance in a modern design of sense

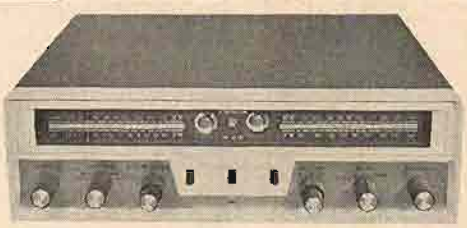
40W Stereo Tuner-Amplifier SM-Q300B

Here is a new amplifier further improved in appearance and performance over SM-Q300, which is widely recognized as the best seller of the year. The newly designed front panel is deluxe in appearance because of the use of a gold-colored fretted material. The frame and the knobs are arranged in perfect harmony with the panel. The output is as high as 40W. The power supply circuit is a voltage-doubling rectifying system using silicon diodes. The main amplifier is provided with a phase-reversing circuit originated by PIONEER engineers to obtain highly stable and distortion-free output.

The tuner is a FM/AM-AM/SW all-wave system with very high sensitivity and selectivity. For FM a multiplex adaptor can also be used. In addition to the use of PIONEER's unique mode-blend control and the 4-gang volume control for cutting down residual noise, the amplifier is provided with rumble, scratch and whistle filters. It is, in fact, a highly versatile stereo amplifier since it is provided with terminals, such as for tape recorder and center channel, for broadening the scope of its application.

Specifications

Vacuum Tubes: 19 tubes 6 diodes; Tuning Range: MW 535-1605Kc, SW 3.8-12Mc, FM 80-108Mc; Input and Gain: MAG. PU 3.4mV, XTAL. PU 38mV, AUX. 160mV, MIC. 4mV; Equalizer: NF type, RIAA curve; Frequency Response: 20 cps—50kc; Maximum Output: 20W x 2; Output Terminal: 4, 8, 16 ohm for speaker (each channel), extra output for center channel amp. and for simultaneous tape recording; Dimensions: 18½ (W) x 14 (D) x 5½ (H) inches



Handy Stereo Amplifier

14W Stereo Tuner-Amplifier SM-Q141

Our new stereo amplifier SM-Q141, designed and manufactured with an eye to easy operation, is now available at a low cost.

Specifications

Vacuum Tubes: 15 tubes 3 diodes; Tuning Range: MW 535—1605Kc, SW 3.8—12Mc, FM 80—108Mc; Input and Gain: MAG. PU 2.8mV, XTAL. PU 28mV, AUX: 500mV; Equalizer: NF type, RIAA curve; Frequency Response: 40 cps—100kc; Maximum Output: 7W x 2; Output Terminal: 4, 8, 16 ohm for speaker (each channel) and extra output for simultaneous tape recording; Dimensions: 16½ (W) x 13¾ (D) x 5½ (H) inches

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EDITOR'S REVIEW

Christmas Present for the Component Industry

HIGH FIDELITY DEFINITION

One of the behind-the-scenes stimuli for much conversation this year has been the attempt by the Federal Trade Commission to arrive at a definition of the term "high fidelity." Activated by this stimulus, the Electronic Industries Association has been attempting to arrive at a definition first. In a previous editorial we noted our belief that this whole search was treading on dangerous ground in view of the difficulty of establishing meaningful standards.

A short time after our editorial appeared we received a copy of the definition proposed by the EIA, wherein they stated that if a set met the outlined standards it would receive *certification* as being of high-fidelity quality. Upon first reading this definition we were highly amused; this was the greatest joke we had seen in a long time. Imagine a standard for high-fidelity certification with only two salient conditions: 1. the amplifier must have a *music power output of 5 watts;* and 2. the over-all system must have a minimum acoustical output which is within 3 db down at 100 cps, and within 6 db down at 8000 cps, from a reference of 80 db (referenced to 0.0002 dyne/cm²) at 1000 cps. Imagine a certification standard which states:

> "All other characteristics, e.g., hum, rumble, wow, stylus tracking, etc. that various people have associated with the term "High Fidelity" have been placed in the category of "Individual Manufacturer's Quality" just as we would consider quality in cabinet construction, trim, etc."

After reading this amazing proposal our humor turned to anger. This proposal is most assuredly the largest bunch of hokum to hit the fan in many a year. How in the world can anybody even attempt to define a term which means "as near the original as possible" without even mentioning distortion? It's the same as if we defined a high-quality car as one which had at least a 10-horsepower engine and could attain at least 20 mph—and nothing more! But we will not attempt to point out all the obvious inadequacies of this definition, but rather we will take note of the apparently deliberate attempt to foster what they must know is a grossly inaccurate definition. We will not speculate as to motives, but we will speculate as to the effect. If this definition is accepted by the EIA and/or the FTC, a large number of consumers are going to be led astray by an official certification. It will not fool the dyed-in-the-wool audiofan, but it may fool the novice. We who know better cannot afford to permit such a deliberately misleading definition to come into being unprotested. We urge every audiofan to write to the FTC and register a strong protest. The address to write to is:

Hon. Paul Rand Dixon
Federal Trade Commission
Washington 25, D. C.

While on the topic of definitions and standards, we would like to note once again our feeling against the proposed standard-rating system(s) for loudspeakers. This proposal is again an EIA affair, which received the original idea from Lincoln Walsh. The weakness of the idea is implicit in the type of thing that happens when one tries to define "High Fidelity" as indicated in the previous paragraphs. Somehow or other the lowest common denominator becomes the standard. For instance, take the Walsh proposal which we previously characterized as containing much science. Even if one agreed with the standards proposed by Mr. Walsh, it takes a great deal of expensive equipment and highly competent personnel to put into effect. This was pointed out by another recent proposal before this same EIA committee. Now it is suggested that since most companies do not have adequate equipment for the Walsh system, why not use a simpler method of testing? Next of course, we might expect a proposal to use only two simple parameters, similar to the ones we reported earlier. The point of all this is not to be cynical and be convinced that we oughtn't to have standards, but rather that the standards should be *methods of measurement* and standards of "quality."

YEAR-END REFLECTIONS

Traditionally December is the month wherein editors look back over the year just past and sum it all up in several well-chosen words. We feel that this tradition has virtue for several significant reasons: First of all we can take a look at the events of the year in the perspective of the events which led to it in the preceding years; secondly we can free ourselves from momentary enthusiasms; and finally we can delineate a trend if a series of events seem so related.

Now that we have laid some groundwork, let us proceed to the matters which are really of moment: FM-stereo and transistors.

FM-Stereo

There seems to be little doubt now that this new broadcast medium has taken its rightful role in the hierarchy of the high-fidelity field; FM-stereo is now just one out of the many topics which concern the audiofan. Surprising as it may sound, this medium has run the gamut from "earthquake" to "minor ripple" in less than a year and a half. This is as it should be. After all stereo was not new, nor was FM multiplex; all that happened was that already existing techniques were put in operation by FCC order. We do not wish to minimize the importance of this newly approved broadcast medium, but certainly the rapid decay of excitement speaks for itself.

Strangely enough, the most significant effect of FM-stereo broadcasting has not yet been highlighted: the emergence of FM radio as a national advertising me-

(*Continued on page 59*)

*Throughout the entire world... more people listen to stereo records reproduced by the STANTON Stereo Fluxvalve than any other magnetic pickup!

*More stereo records are quality controlled and reviewed by professionals using STANTON Stereo Fluxvalves.

*More high quality phonograph consoles use STANTON Stereo Fluxvalves than any other magnetic pickup.

*More commercial background music systems use STANTON Stereo Fluxvalves than any other magnetic pickup.

*More automatic phonograph systems use STANTON Stereo Fluxvalves than any other magnetic pickup.

And now...new dimensions for stereo from the world's most experienced manufacturer of magnetic pickups–

STANTON 481

Calibration Standard Stereo Fluxvalve*

Model 481AA STANTON Stereo Fluxvalve—an ultra-linear professional pickup for use with ultra-light-weight tone arms capable of tracking within the range from 1/4 to 3 grams. Supplied with the D4005AA V-GUARD diamond stylus assembly.
AUDIOPHILE NET PRICE $49.50

Model 481A STANTON Stereo Fluxvalve—an ultra-linear professional pickup for use with manual tone arms, recommended tracking force is from 2 to 5 grams. Supplied with the D4007A V-GUARD diamond stylus assembly.
AUDIOPHILE NET PRICE $48.00

Model 481E STANTON Stereo Fluxvalve Set—same as the Model 481A but includes two additional V-GUARD styli: the D4010A 1 mil for LP's and the D4027 2.7 mil for 78's.
AUDIOPHILE NET PRICE $60.00

STANTON 400

Professional Stereo Fluxvalve*

Model 400AA STANTON Stereo Fluxvalve—an ultra-linear professional pickup for use with ultra-light-weight tone arms capable of tracking within the range from 1/4 to 3 grams. Supplied with D4005AA V-GUARD diamond stylus assembly.
AUDIOPHILE NET PRICE $40.50

Model 400A STANTON Stereo Fluxvalve—an ultra-linear professional pickup for use with manual tone arms, recommended tracking force is from 2 to 5 grams. Supplied with D4007A V-GUARD diamond stylus assembly.
AUDIOPHILE NET PRICE $39.00

Model 400C STANTON Stereo Fluxvalve—an ultra-linear professional pickup for use in automatic record changers, recommended tracking force is from 4 to 7 grams. Supplied with D4007C V-GUARD diamond stylus assembly.
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"Fine audio components from the Professional Products Division of"

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PICKERING & COMPANY, INC., Plainview, N. Y.

*The hermetically sealed STANTON Stereo Fluxvalve is warranted for a lifetime and is covered under the following patents: U.S. Patent No. 2,917,590; Great Britain No. 783,372; Commonwealth of Canada No. 605,673; Japan No. 261,203; and other patents are pending throughout the world.

The pace-setting new S-2100 FM Multiplex/AM stereo tuner

THE EXTRAS THAT ARE STANDARD ON SHERWOOD

Stereo Light . . . Gives instant identification of those FM stations broadcasting stereo programs. Special sensing circuitry (pat. pend.) prevents false indication due to noise impulses, etc.

Wide Band 3-mc Gated-Beam Limiter and 1-mc Balanced Ratio Detector . . . Combine to suppress the background noise introduced by stereo FM, and create the pace-setting capture effect of 2.4 db.

Automatic Frequency Control . . . Electronically locks and holds the exact center of separation of the FM stereo signal.

Fly Wheel Tuning . . . Made with turntable accuracy for easiest, fastest tuning.

FM Interchannel Hush . . . Eliminates irritating "rushing" sound between stations when tuning.

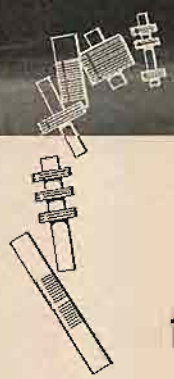
Dial Spread . . . Only Sherwood offers communication-type 20%-longer scales, with professional calibrations for slide-rule accuracy.

specifications

FM Sensitivity: 1.8 μv. for —30 db. noise and distortion (IHFM). **FM Selectivity:** 200 kc. @ —3 db. **FM Detector:** 1.0 Mc peak to peak. **FM Distortion:** ⅓% at 100% mod. 14 tubes plus rectifier plus 9 diodes.

SHERWOOD MODEL SL-1 STEREO INDICATOR LIGHT

The only indicator light that rejects all false signals and identifies only true stereo broadcasts. Adjustable sensitivity — functions with any FM tuner. Small enough (2¼" x 2½" x 7½") to mount inside cabinet. $29.50.



S-2100 Tuner: $199.50. (Fair Trade). With Walnut Leatherette Case, $207.00. Full year warranty.

Who cares whether the coils are wound on Mylar*? Only Sherwood—and you.

A good modern stereo tuner may contain over 1,000 component parts. Among those especially critical to sound quality are a dozen or more coils. These coils are the "nerve ends". They can make or break performance on drift . . . distortion . . . selectivity . . . sensitivity.

No place for a "standard" part, we feel.

That's why Sherwood—and Sherwood alone—custom designs all its coils. Only Sherwood winds them on low-loss Mylar forms. And Sherwood employs temperature-compensating ceramic capacitors across all its IF coils.

These refinements cost more, but the result is worth it: Complete freedom from temperature and humidity variations guaranteeing precise tuning . . . minimum distortion . . . no loss of sensitivity.

The Sherwood Coil is just one reason why we say "the care that goes in determines the quality that comes out".

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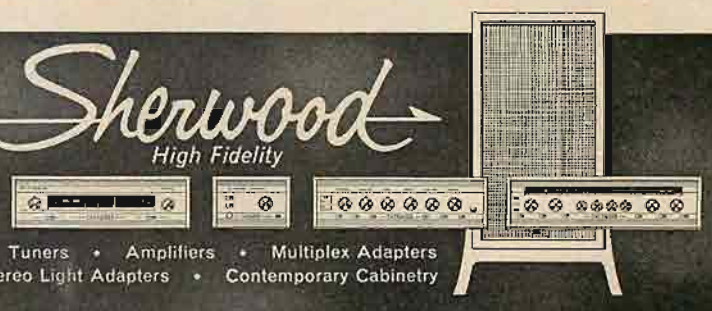

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Another Word on Multiple Speakers

JOHN W. WARD*

The natural fall-off of frequencies above 4500 cps and below 200 cps, plus smooth handling of frequencies between, make this 12-speaker parallel-series array valuable as a mid-range speaker with a minimum crossover network.

NOVAK[1] HAS DISCUSSED in some detail the performance of a 32-speaker series-parallel array of "replacement-quality" 6-inch units, in comparison to commercially available conventional speaker systems of comparable over-all price. He concluded, and rightly so, that as a full-range system the virtues of the multi-speaker array have been highly overrated. His major points were: 1. The high-frequency response is compromised; 2. frequency response is ragged in the 1000- to 3000-cps range; 3. low-frequency response is very poor; 4. polar pattern is unsatisfactory (when mounted horizontally).

Although Novak convincingly demonstrated these points with excellent supporting data, there are some facts not yet uncovered, which have become apparent to some of us who have lived a length of time with these systems and who have subjected them to some tests.

Preliminary Observations

The first system was constructed by a group of scientists and engineers here at Los Alamos who were intrigued by the early articles on the subject. This system was essentially identical to the 28-speaker array described by Mahler.[2] Although the rig sounded very nice, response studies with a test record (and later more elaborate equipment) showed that response was flat only to 200 cps and that 100 cps was decidedly weak, with no really usable sound much below this frequency. Also, the high-frequency response fell rapidly above 4500 cps (without tweeters) and the response curve was very ragged above 1500 cps. These results essentially duplicate those already noted by Novak.

Actually it should be intuitively obvious to anyone who gives this any serious thought that the high frequencies would fall off in this manner. Olson[3] has shown that a typical cone radiator begins to cut off above 6000–7000 cps (due primarily to cone mass). Therefore, an array of such units must cut off somewhat sooner, because the speaker spacing begins to approach the wave length of sound at about 2500–3000 cps, and cancellation will occur.

However, the low-frequency behavior is another and considerably more complicated problem.

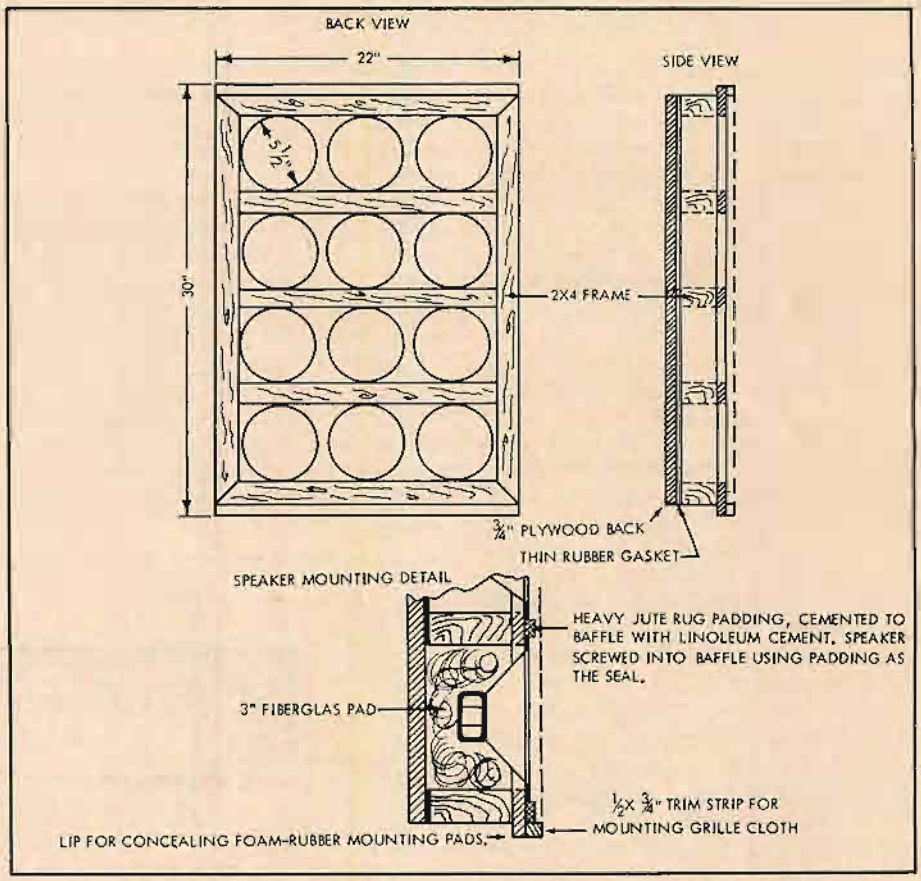


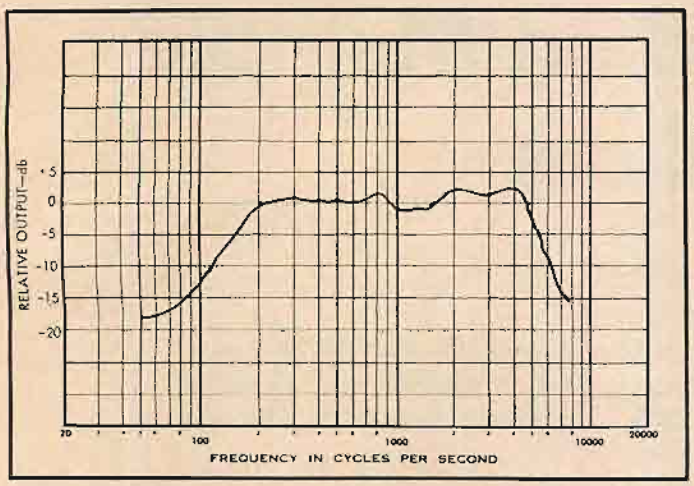
Fig. 1. Details of speaker mounting and construction of the enclosure for a 3 × 4 array.

Tests

Most if not all the data on multiple speakers has been reported on series-parallel arrays of varying size. Now it again should be evident, with a little thought, that such an array ought to be connected in *parallel-series*, in order that the speakers may "see" each other and exert some damping. The 28-speaker (22 6-inch speakers) array described above was rewired in this manner, and two immediate improvements resulted: first, almost 5 db was knocked off the hump at the resonant frequency of the system, and second, considerably smoother response (±4 db) was noted above 1000 cps.

It was therefore decided that a considerably more refined array should be constructed. This system consisted of 24 3.16-oz. magnet speakers in a 3×8 array. These higher-quality speakers were obtained at about $2.00 each by carefully watching for speaker sales. Several different brands were purchased, and the resonant frequency of each

* *2111 Lead SE, Albuquerque, New Mexico.*



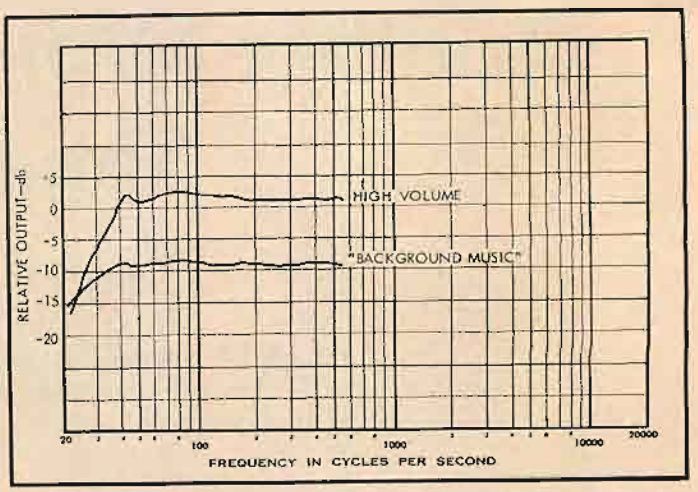


Fig. 2 (left). Frequency response of a closed-back system. Fig. 3 (right). Frequency response of system in very large enclosure.

speaker was measured. Speakers were then selected so that in each group of three (wired in parallel), three decidedly different resonant frequencies were used, as for example 86, 97, and 111 cps. Each group of three was then put in series with the next, to make up a total impedance of about 8 ohms. These speakers were mounted on a baffle of ¾-in. plywood, 22 × 60-in., which was screwed and glued to a 2 × 4-in. frame with each group of three speakers isolated by a 2 × 4-in. cross brace. Therefore, with the back closed, each group of three speakers was effectively enclosed in a small box, which was filled with Fiberglas. The front surface of the baffle was covered with heavy jute rug padding, and the speakers were mounted *externally*. Thus reflections of the emergent wave off the baffleboard were minimized, and refractions normally occurring at the edge of the speaker mounting hole were eliminated. Details of mounting and construction are shown in *Fig.* 1.

The frequency response of the *closed-back* system (measured on-axis, suspended 10 feet off the ground) is shown in *Fig.* 2. Equipment used for this test and subsequent tests was as follows: Altec 21D condenser microphone, Hewlett-Packard model 200C audio oscillator, Hewlett-Packard model 400C audio voltmeter, Heathkit Model OM-3 oscilloscope, and a Knight KN-85 power amplifier. This response curve generally corresponds to that found by Novak, with the exception that the high end is very much smoother, and no really measurable resonant-frequency hump was found. These improvements we attribute to the parallel-series wiring and the selection of speakers with regard to their resonant frequencies. To what extent the generally higher quality of these speakers and the heavier magnet adds to this result cannot be easily evaluated. The system behaves as a closed-box baffle should, dropping off at about 12 db/octave below the apparent resonant frequency (about 200 cps). Attempts to boost the bass of this array produced audible doubling below 85 cps. This was checked with Lissajous patterns on the oscilloscope, and doubling set in at just above 90 cps.

Next, the back was removed from the array, and the baffle was mounted in the doorframe of a 10 × 10 × 8-foot outdoor shed. The frequency response (ignoring spikes due to building reflections) is shown in *Fig.* 3. There was clean bass at reasonable (typical audiofan!) volume levels to 50 cps. This can only be explained by the coupling phenomenon that has been proposed and/or discussed by several authors.[4, 5] The response rose slightly at 45 cps, indicating a resonance. At this frequency the sine-wave output as viewed on the oscilloscope began to look a bit ragged, and the 24 cones were moving vigorously for a loud signal. Below 45 cps the response fell very rapidly, and attempts to boost in this region produced first doubling, and finally raucous breakup. At "background music" levels the response below 45 cps fell less violently, as also shown on *Fig.* 3.

The array was then mounted in place of the door of a large (about 100 cubic-foot) closet, and, if one can truthfully sort out the room resonances at these low frequencies, the bass performance seemed almost as good as that noted in the outdoor test. It should be

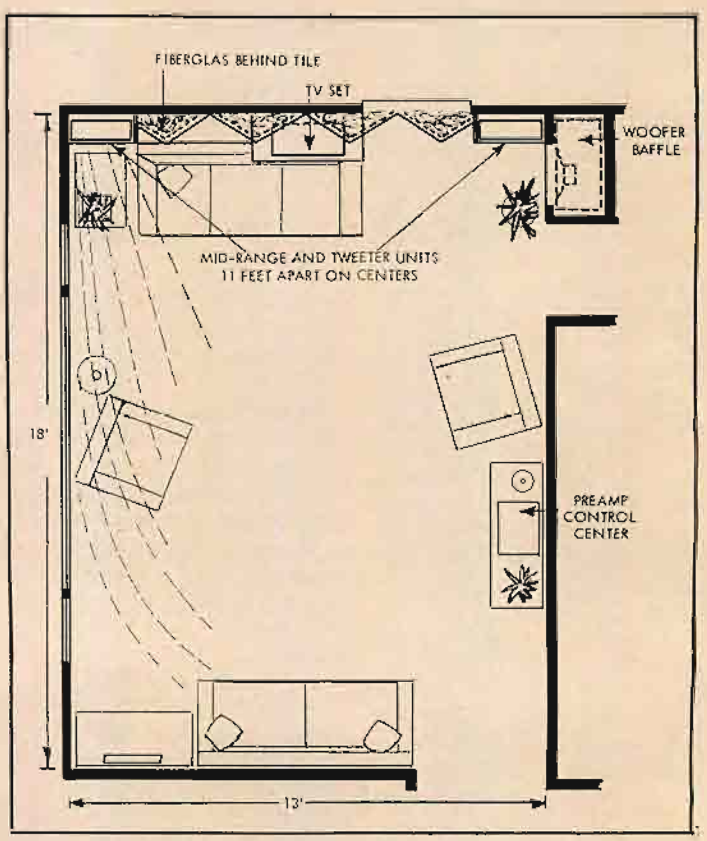


Fig. 4. Floor plan of the listening room.

mentioned at this point that the owner of the original (28-speaker) array, after seeing these results, added volume behind his baffle to make a total of 10 cubic feet, and also achieved usable bass to 50 cps, although a slow drop totaling about 5 db was noted between 200 and 50 cps, for this system. Also, his rig would not handle as much low-frequency power without doubling as the 24-speaker array with heavier-magnet speakers.

It might be well at this point to summarize the main conclusions of these tests:

1. It is of at least academic interest that, under proper conditions, the low-frequency coupling phenomenon does occur. The primary prerequisite is a low enough effective resonant frequency so that the coupling may take over. Thus as has been demonstrated, a *large baffle volume* is needed, further helped by speakers of naturally low resonant frequency and with heavy magnets. The average resonant frequency of the speakers in the 3 × 8 array was at least 40-cps lower than that of the cheaper speakers used in the first system tested.

Fig. 5. Photograph of the sound wall.

2. In wiring the array in parallel-series, very smooth response was obtained for the closed-back model over the range 200–4500 cps. The contribution (in this frequency range) of the heavier magnet and/or generally better quality is difficult to evaluate.

3. Even with coupling occurring, the 3 × 8 array is useful to only 50 cps, a figure attained by many smaller and simpler systems. Perhaps a 4 × 6 array would be more efficient, but in the main, it appears as if *many* more than 24 high-quality 6-in. speakers would be needed to realize response to 20 cps.

Therefore, it would seem that to build a really good full-range multi-speaker system the requirements are: 1. *many* good speakers; 2. test equipment; 3. *large* baffle volume (or a closet, between room mounting and so on); 4. a good tweeter. This is clearly an expensive, bulky, time-consuming proposition, and *just isn't worth it!* The polar response of an even larger array should be very poor.

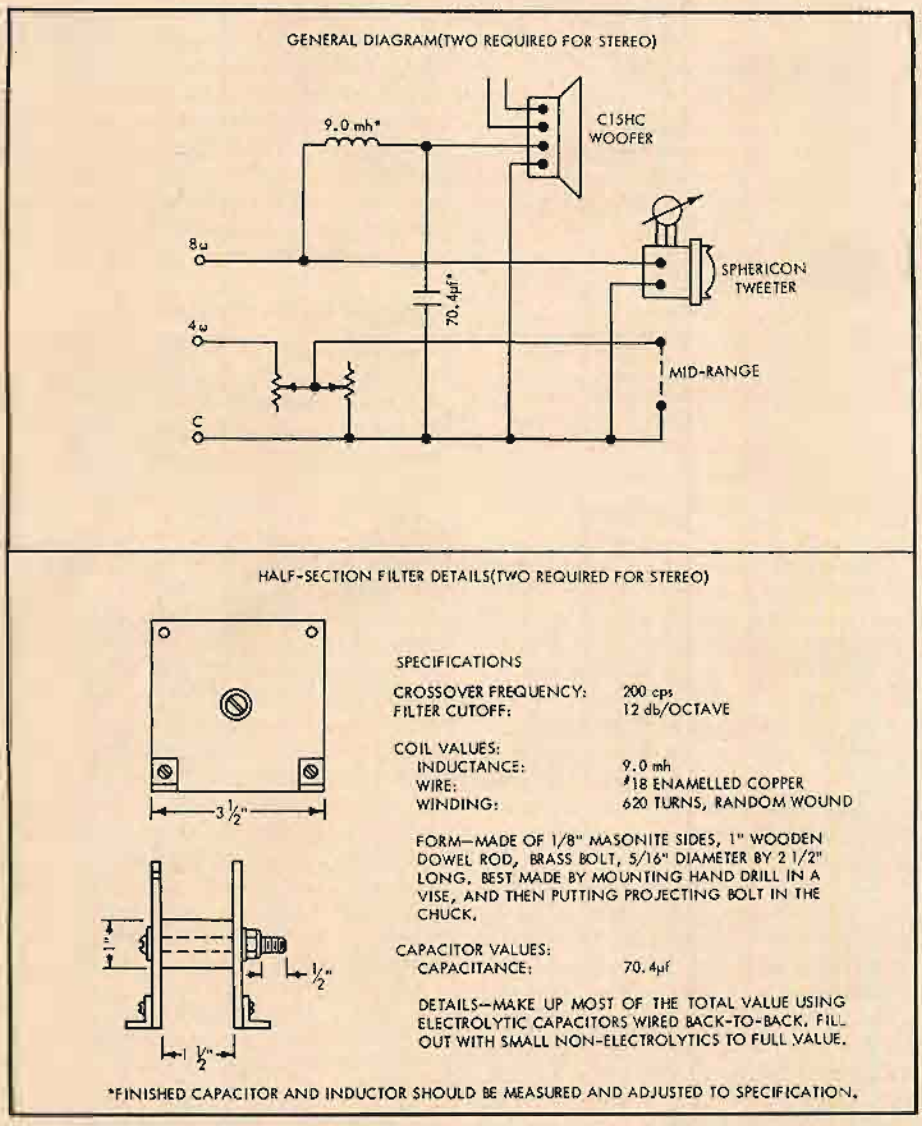


Fig. 6. Schematic and construction details of crossover network.

The Multiple Array as a Mid-Range Unit

It was noted above that the closed-back 3 × 8 array gave very smooth response in the range 200–4500 cps. I divided this baffle into two identical 3 × 4 arrays (for stereo). To each was added (but on a separate, heavily padded board) one of the new wide-dispersion University T-202 "Sphericon" tweeters. These combined units have been A-B tested and compared with many fine hi-fi systems here (encompassing small sealed box, small ported box, reflex, and horn-type systems). On program material with severe transients (guitar, percussion, jack-hammer, and such) the difference is quite marked. It is my contention that the array can follow the true input signal, in the midrange, to a degree of exactness not possible with a conventional unit. Also, of course, the distortion becomes much smaller by dividing the signal among many speakers, a fact already discussed in earlier articles.

Let us then list the advantages that the parallel-series multiple array in a closed baffle offers as a mid-range unit, especially for stereo: 1. excellent transient response; 2. very low distortion; 3. slim baffle, suitable for inconspicuous wall mounting; 4. broad sound source; 5. natural fall-off at high frequencies, making the addition of a tweeter very simple; 6. natural fall-off (12 db/octave) below 200 cps, eliminating the need for a full crossover network associated with the mid-range, thus preserving the transient response, which might be compromised by an inductor.

I have crossed over at 200 cps into a common-bass system, using a University C15HC 15-in. high-compliance dual-voice-coil woofer and half-section (12 db/octave) filters in front of the woofer. Since the University tweeter comes in at 3000 cps, a 2-μf capacitor was added to bring the high-frequency crossover to the 3-db point of the midrange. There are of course L-pads associated with both the tweeter (built in) and mid-range.

I therefore have a direct-radiator speaker system from about 30 cps on up, and the actual measured response of this complete system outdoors was ±3 db from 21 to 22,400 cps. Of course such response can never be accomplished in the average living room, but it is an impressive system, both aurally and on paper. Total cost of all speaker units and crossover components, slightly under $200.

I will freely admit, however, that if one assigns value to the countless hours, "blood, sweat, and tears," and so on, that went into the understanding of how these things work, the system is priceless.

Installation in a Music Wall

As indicated earlier, the mid-range unit, by virtue of its slim cross-section, is ideally suited for wall mounting. These units were built into a "music wall" in my home, as shown in the photograph. The tweeter baffle boards are located directly below the mid-range speakers along with the L-pad controls. The tweeter boards are covered with ¾-in. Fiberglas. Between the two speaker units is a decorative wall made up of acoustical tile. The tiles are mounted in a saw-tooth arrangement, and the space behind is filled with Fiberglas. The television set, centrally mounted on a cantilevered shelf, can be played through the system. Sound was brought off the top of the volume control and over to the preamplifier by means of two sub-ouncer high fidelity impedance-matching transformers. General details of the room are shown in *Fig.* 4 and 5.

Although saw-tooth wall construction is often used in special sound chambers, I suspect that in this application the effect is primarily decorative. However, the tile and Fiberglas construction has a significant effect on standing waves of all but the lowest frequencies, and in the region from 150 to 400 cps these waves rapidly diminish in intensity. Above 500 cps the room is very "clean" though still reasonably live, and the very high frequencies come through with especially good clarity. The side walls were deliberately left hard, with the idea that the stereo sound can "wash" down these walls and spread into the room, as indicated in *Fig.* 4.

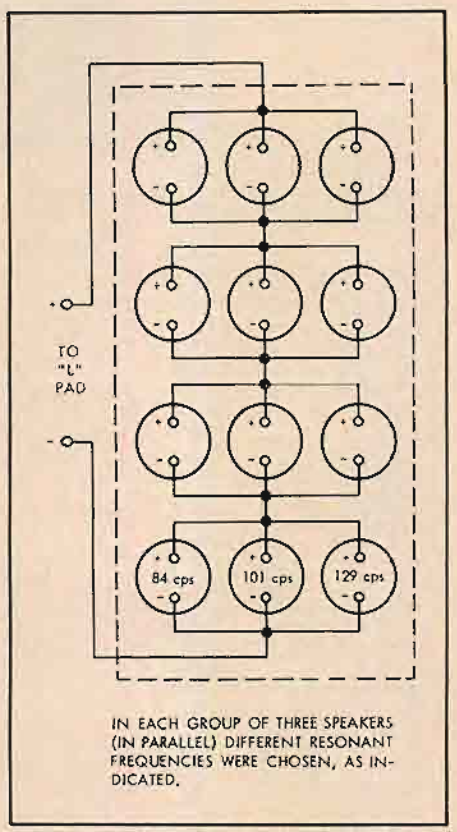


Fig. 7. Parallel-series wiring of array.

The mid-range units are isolated from the building by virtue of being wedged top and bottom into the alloted space on foam-rubber pads (see detail of *Fig.* 1). Since all speaker baffles and the wall between are covered with acoustical material, most of the mid- or high-frequency sounds that are heard must emanate from the speakers or the reflections from the side walls, with essentially no reflections of the emanating wave from the source wall.

The woofer is mounted in a 10-cubic-foot baffle located under a half-closet on the right side of the room. This box is constructed of ¾-in. plywood and heavily braced. The entire interior is covered with a glued-on layer of rug padding, further covered with 3-in. of Fiberglas. Because of the large volume, a 3 × 4-in. port (duct length ¾ in.) could be used. Half-section filters used with this woofer were constructed using data drawn from a book on crossovers by Tremaine.[5] Values for a 200-cps crossover looking into an 8-ohm impedance, construction details, and circuit of the entire system are shown in *Fig.* 6 and 7.

The stereo effect is most rewarding. The whole listening end of the room provides good stereo, and one cannot ever locate sound as coming from one speaker or the other. Rather, the total effect is that of a large auditorium, and as one moves back and forth in the room the feeling is that of moving from one side to the other of the concert hall.

I believe that this feeling of spaciousness and realism is due to three specific things: 1. the arrangement of the listening room; 2. the broad source presented by the mid-range units; and 3. the wide-dispersion point-source tweeters.

A number of manufacturers now sell this type of tweeter, and for lack of coloration, wide frequency response, excellent dispersion, reasonable power requirement, and moderate cost they are hard to beat. When used with the multi-speaker mid-range unit an excellent sound transducer is achieved.

I should also like to recommend the moderate efficiency long-throw woofer of 15-in. size, mounted in a properly designed ducted enclosure. Novak[7] has discussed in detail the theory and principles of operation of this kind of system. A number of manufacturers market such speakers, the University being especially nice for stereo because of the dual voice coil features.

Summary and Recommendations

Although not acceptable as a full-range system, the multi-speaker array makes an extremely fine reproducer of the vital mid-range frequencies. Of special interest is the elimination of complicated and expensive crossover networks.

For those who would contemplate building such units, I would strongly suggest that time be taken to measure and match the speakers as outlined above, before wiring in *parallel-series*. I realize that lack of test equipment and/or know-how might make these techniques unavailable to many people. Alternatively, I would suggest buying different speaker brands, and assembling these while trusting to luck.

For those people who may have built multi-speaker systems and are unhappy with them, I would of course recommend breaking them down into mid-range units, and adding a good woofer and tweeter. I believe the results are well worth the effort. AE

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2. C. F. Mahler, Jr., "The series-parallel speaker array," AUDIO, November, 1960.

(*Continued on page 63*)

A 125.5-db 1-Megacycle Audio Attenuator

WEAVER DODGE*

Utilizing completely independent pi sections, this 125.5-db 600-ohm attenuator costs 1/3 to 1/6 the price of a commercial unit.

FEW PIECES OF TEST EQUIPMENT are easier to build and none more useful than our old friend, the attenuator. Unfortunately, few home experimenters have them, due in part to the lack of any kit company marketing one and the forbiddingly high price of commercially available ones. This is really a shame since the amateur seldom has at his disposal test equipment with truly linear amplitude response. Response measured as 3 db down on a home scope may be only approximately correct depending on how much of the screen face is used. When equalization curves are checked the results can be very inaccurate since utilization of quite a large portion of the screen face is necessary. Kit VTVMs are scarcely better as can be appreciated when one has an attenuator to check them out.

To overcome this limitation the author has built a 125.5-db 600-ohm attenuator for the purpose of calibrating test equipment and checking equalization accuracy, amplifier capabilities, and the like. The attenuator can also provide an accurately controlled and precise signal of sufficiently small amplitude to feed into low-level input stages to measure input noise and hum. This is the only way you will ever know for sure whether your hiss is 1 or 100 microvolts.

For construction, 10 toggle switches were used, one for each attenuation step. As shown in *Fig.* 1, all ten are laid in a line on a 3½ by 19 inch rack panel. This construction provides minimum capacitance between sections and hence maximum accuracy at higher frequencies. Actually, when loaded with 600 ohms on both ends, the uncompensated response rises only slightly at 1 megacycle with all switches thrown. For this reason very little frequency compensation is used since little is necessary. Compensation consists of one 150-pf capacitor placed across each 40-db pad. This capacitor was chosen more or less empirically with both 40-db switches thrown and a scope of 20-pf input impedance connected to the attenuator output. This capacitor acts as a voltage divider and tends to lower the response as much as stray capacitance raises it. No compensation is needed on the other db pads since the series resistors are smaller and swamp out capacitive effects. The switches are wired as shown in *Fig.* 2. The basic building block is the pi section, and the series and two shunt resistors are so wired that they are bypassed when the switch is off and properly grounded when the switch is thrown the other way.

The complete attenuator, then, would look like *Fig.* 3 if every switch were thrown. The only serious difficulty to be

(Continued on page 64)

* *1714E Glen Keith Blvd., Baltimore 12, Md.*

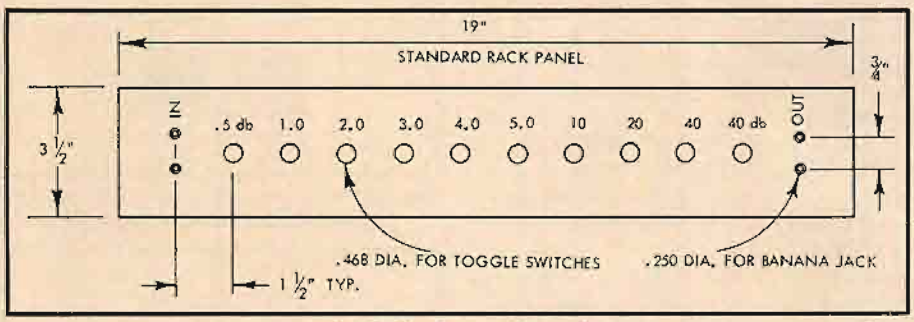

Fig. 1. Front panel layout.

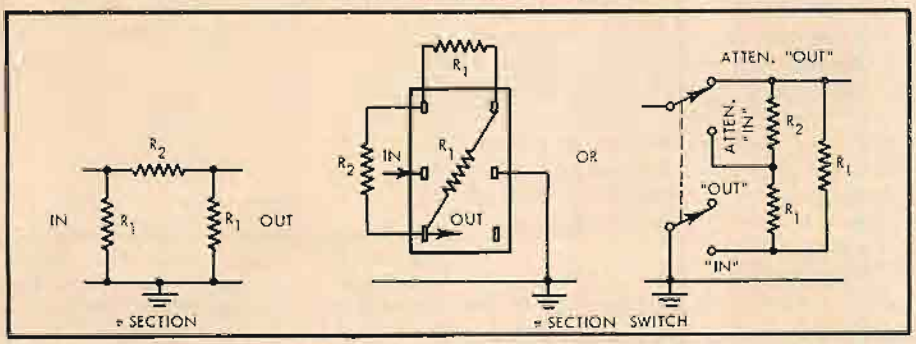

Fig. 2. Schematic representation of pi section and switch plus wiring diagram of switch.

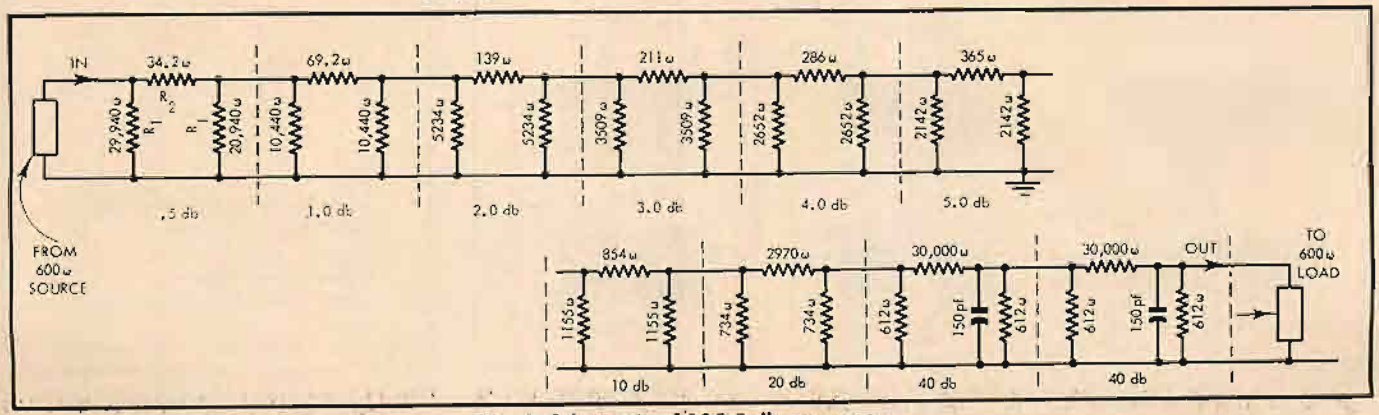

Fig. 3. Schematic of 125.5-db attenuator.

Leakage Inductance— A Useful Circuit Component

NORMAN H. CROWHURST*

The leakage inductance of audio transformers are useful in filter circuits, stereo output transformer combined with a crossover network, and improving transformer-to-speaker matching.

THERE SEEM TO BE two reasons why leakage inductance is not utilized very much more than it is for audio work: 1. It's a subject about which there is much misunderstanding; 2. its utilization involves a rather specialized occupation, performed mostly by people with little interest in exploring such avenues, transformer manufacture. The fact remains that, for a variety of applications, it has unique advantages, making it well worth giving consideration. In varying combinations, use of leakage inductance can improve efficiency, reduce interaction, give better performance, cut cost, reduce size, and simplify production.

The usual concept of leakage inductance is derived from mutual inductance. If two coils are wound on the same core, they will each have an inductance, which we may designate by L_1 and L_2, proportional to their respective numbers of turns squared. They will also possess a mutual inductance which, using the same proportionality, would be a function of the turns product, in theory multiplied by a constant k, which is very nearly equal to unity—of the order of 0.999.

As the three quantities, L_1, L_2 and M (mutual inductance) are each functions of the non-linear magnetizing characteristic of the core material, which causes their value to vary by several orders of magnitude greater than the difference of this theoretical k from unity, k is usually assumed to be unity in such a component. However, it never is unity, and its difference from unity makes itself known in the form of leakage inductance.

Because k is so close to unity, it seems inevitable that it must be very close to a constant value, even though quantities L_1, L_2 and M deviate quite widely due to core nonlinearity. Therefore, according to a sort of mathematical logic, one would expect $(1-k)$, which is a factor of leakage inductance according to this concept and definition, to have a similar deviation, or lack of it. What gets overlooked is the possibility, which turns out to be a fact, that leakage inductance can be extremely close to constant, while L_1, L_2, M, and $(1-k)$ are having the wildest deviations!

To see why this is, take a look at the physical basis for the quantities, shown in *Fig.* 1. At (A) observe that the magnetic flux (dashed lines stays in the core material and encloses both windings. It is this flux that is a non-linear function of magnetizing current in the primary. Until some current is drawn from the secondary winding, there is no leakage flux, and the e.m.f. generated in the two windings is strictly proportional to their respective turns, even to the nonlinearity of waveform.

When current is drawn from the secondary, a balancing current flows in the

* *Gold Beach, Oregon.*

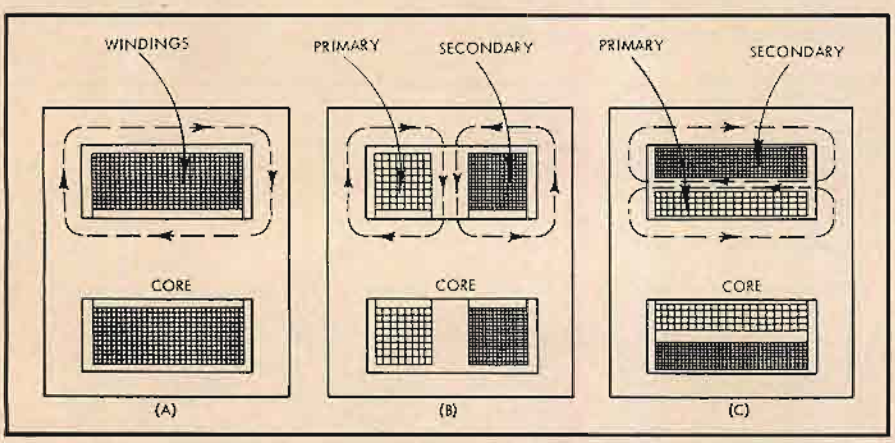

Fig. 1. The basic difference between main magnetic flux (A), and leakage flux (B) and (C).

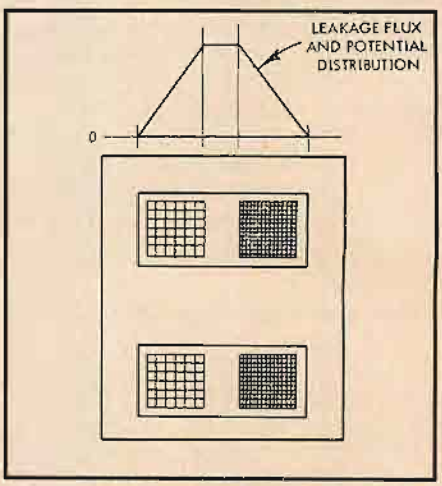

Fig. 2. The geometry of leakage flux through the windows (see text).

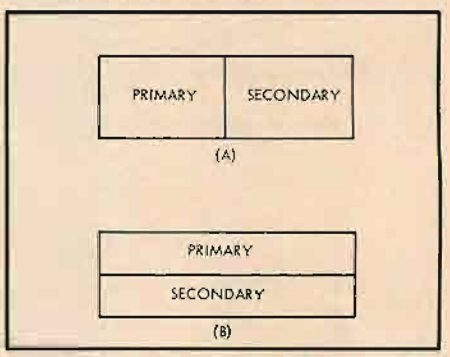

Fig. 3. Two simple ways of arranging windings in standard window shape makes leakage inductance change in ratio 9:1.

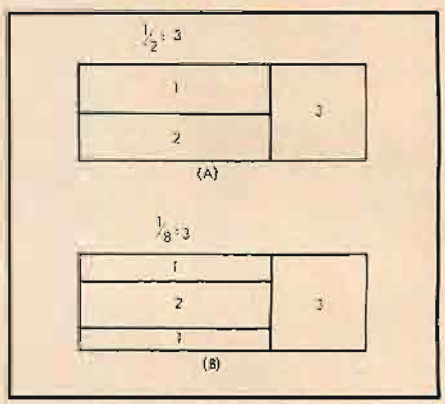

Fig. 4. Two arrangements for combination of tight and loose coupling between different windings (see text).

What should a good turntable do? Easy to put into words...move the record at the exact specified speed, without variation, and without inducing distortion. Here's how the Empire Troubador turntable achieves that goal: • Empire 208 belt-driven 3-speed "silent" turntable • There are only two moving parts in the 208, the motor and the turntable platter—precise bearing tolerances in those parts • Each motor and each turntable are individually adjusted to perfect dynamic balance • Complete rumble isolation is provided by the motor suspension, flexible belt drive and the resilient nylon "seat" which supports and cushions the thrust of the main bearing • A case-hardened, lapped steel shaft fits precisely into the bearing well (honed to a micro finish)—a hardened steel polished ball on the underside of the shaft rests on the nylon seat in the Empire 208 • Total vibration limited to less than 1/1,000,000th of an inch • 3 speeds, 33⅓, 45, 78 rpm • Constant speed, heavy duty hysteresis-synchronous motor operates independent of variations in current fluctuation • Continuous flexible belt—perfectly ground to constant thickness ± .0001 inch, couples turntable directly to the motor pulley—no intermediate idlers • Acoustic isolation motor suspension • Fine speed control • Push button power control with on-off light • Optimum distribution of turntable mass; 6 pound heavy machined aluminum, individually balanced to precise concentricity • Machined heavy aluminum base plate • Safety suspension rubber mat • Retractable 45 rpm adapter • Rumble better than —65 db • Wow and flutter less than .05% • Satin-chrome or satin-gold finish turntable, $110. (slightly higher west of the Rockies) • Handsome walnut base for 208 turntable, $15. • The "American Record Guide" (Larry Zide column) says of the Empire Troubador turntable: "I found speed variations—that is, flutter and wow—to be inaudible...vibration was extremely low ...rumble figures have not been bettered by any turntable I have tested...the heavy turntable is driven via a belt by a synchronous motor, thus assuring the user of constant speed, regardless of minor line variations...just as a tire is smoothed at high rpm, so the turntable's vibration is reduced and kept low by carefully balancing it...it is attention to this and a number of similar features that make the 208 the value it is" • Don Hambly, station manager of KRE AM/FM, Berkeley, Calif. said: "We have long realized that belt driven tables would be the best to use, but had not been impressed with those on the market...the Empire tables, however, have all the basic requirements of design and simplicity of operation and maintenance that we have sought" • "Audio" magazine's "Equipment Profile" of the 208 said: "A massive turntable with precise performance...individually balanced...the truth of the latter may be observed by lifting the platter up and away from the mounting plate and turning it over...notice the holes drilled to balance the platter in a procedure similar to the way automobile tires are balanced...the turntable platter rides on a ball bearing at the end of an accurately honed 7/16" diameter shaft...the shaft rides in an equally accurate well, while the ball bearing rides on a nylon thrust bearing...a spiral oil groove is cut into the shaft to ensure lubrication of the bearing surfaces...the motor is mounted to the plate by means of three soft rubber shock-mounts which prevent the vibration of the motor from being transmitted to the platter...thus, because of the compliant drive belt, the motor is completely isolated from the record-bearing elements...the entire turntable system is acoustically isolated by means of ball-shaped soft rubber feet...we tried to induce acoustic feedback by placing the turntable on top of our large speaker system and turning up the gain: we were unsuccessful...total rumble measured better than —62 db, and wow and flutter were less than 0.1% rms, quite accurate" • (Still with us? Empire's advertising agency said people wouldn't read this much copy...the company felt that the serious music lover would) • "High Fidelity" magazine said of the 208: "Bold appearance which suggests massive and reliable construction—an impression which is quite borne out by its performance tests...the various pieces of the turntable are carefully machined aluminum castings, thick enough to provide extreme rigidity...finely machined shaft...wow and flutter, with the 'Troubador', were completely undetectable by ear...rumble also was completely inaudible, even at high listening levels...the hum field above the platter was completely negligible...starting torque was good...speed accuracy very good" • What should a good arm do? It should hold the cartridge in place as the stylus follows the record in the groove...without detracting from the performance of the cartridge • Here's how the Empire 980 Arm achieves this objective: • Better dynamic balance achieved by locating the pivot points at the precise center of the arm's mass—equal mass on both sides of axis. Once in balance in one plane it is balanced in all planes. This permits the 980 arm to track at lowest levels, gives it its rock-like stability that will allow perfect tracking at any angle—even upside down • Lowest inertia achieved by critically calculated distribution of arm mass • Maximum compliance means it yields to the slightest impulse, responds and moves effortlessly, even with a tilted table, a badly warped record, or with the turntable turning upside down. There's no need to level your turntable. The only problem you would have in playing this arm with the turntable upside down would be keeping the record up there • Free suspension—Incredible responsiveness would be another way of saying this same thing • Precision ball bearing suspensions—both the vertical and lateral pivot bearings of the 980 are suspended in precision steel-ball races, precision manufactured to instrument tolerances...vertical and lateral friction are both virtually unmeasurable, permitting high compliance and minimum hysteresis • Lowest fundamental resonance frequency: 8 cps (the lowest ever achieved in any arm), achieved by increasing the rigidity of the arm structure through weight distribution, and by making the cartridge shell an integral part of the arm • 5 wire circuit eliminates ground loops, hence eliminates the hum that ground loops induce • Easy plug-in installation...no wiring or soldering necessary • Self-latching arm rest...a slight push downward on the arm tube latches the arm in position • (You're making our advertising agency look silly by reading this far—score yourself a fairly serious music lover) • Precise stylus force adjustment...calibrated knob dials any stylus force from 0 to 8 grams with an accuracy of 0.1 gram. The application of stylus force does not upset the delicate balance of this arm, because stylus force is not adjusted by moving a counterweight (thus shifting the center of mass). Rather, a linear-torque coil spring acts directly on the pivot shaft at the center of the arm's mass • Arm offset angle: 23.8° • Satin chrome or satin gold finish, $50. • Lowest tracking force possible, because of extreme compliance and low inertia • Counterweight zero balance adjustment for any cartridge from 2-25 grams • Maximum tracking error ± .650° • No acoustic feedback • Exact cartridge positioning, quick-release bracket-mount secures cartridge to arm shell. Stylus is aligned with front edge of cartridge mounting plate for exact overhang dimension • Dyna Lift (Patent Pending) lifts arm from record at play out • "High Fidelity" magazine's equipment report said: "The spring-loaded 12-inch 980 Arm moves exceptionally freely about its pivot points, indicating very well-made bearings" • "American Record Guide" (Larry Zide column) said: "One of the best available...substantial reduction in vertical mass...a cartridge of any dimensions can be aligned in the head for minimum tracking error...calibration is extremely accurate...Dyna Lift most useful...lateral and vertical friction is exceptionally low...exceptionally stable...steady even with shaky floors..." • "Audio" magazine's equipment profile said: "Much thicker walled tubing in the arm to reduce the fundamental resonant frequency, which is now below the lower limit of our test record" • (This settles it, once again the client knows better than the agency—score yourself a dedicated music-loving audiophile for reading this far) • What should a good cartridge do? This, the most complicated component in a record playback system, has a job to do that can be stated with a simplicity that belies the complexity of accomplishing it. It should translate mechanical energy into electrical energy without introducing distortion. And for maximum life of the stylus and your records (not to mention reduced distortion) it should perform this function at as slight a stylus force as possible • Here's how the Empire 880p cartridge achieves these objectives: • Lowest dynamic mass, less than .5 x 10^{-3} grams • Highest compliance, 30 x 10^{-6} cm/dyne...Lower dynamic mass and higher compliance than any other cartridge made—eliminates distortion and makes possible many of the cartridge's other accomplishments • Performance range 6 to 30,000 cps, well beyond the range of human hearing • Channel separation more than 30 db—greater separation than any other cartridge means greater enjoyment of stereophonic sound • Tracking force as low as ¼ gram—lowest in the industry—at such low tracking force, the 880p not only eliminates record wear, but also eliminates distortion • Longest possible cartridge life insured by lightness of stylus and the low dynamic mass of the magnetic element. It's the last cartridge you're ever likely to buy • The amazing "Dyna-Life" Stylus (Patent Pending)—ultra-sophisticated hand-polished .6 mil diamond—world's lightest • Complete freedom from hum pickup: the Empire 880p incorporates a complete mu-metal shield to prevent stray hum in the cartridge • Fully compatible for stereo or mono • "Moving Magnet" principle ...the superiority of this type of design lies in the extremely light and flexible stylus assembly it permits, in the unusually smooth frequency response and the high electrical output of the cartridge • Balanced high output, 10 millivolts per channel ± ¾ db, etc. • Perfectly translates and responds to the intricate movements of the record groove • Stylus inertia approaches the irreducible minimum • Smooth, wide response • Inspected at each phase of its manufacture • Faithfully responds, instantly, effortlessly, favoring neither one wall nor the other • Empire 880p, $47.50 • Natural performance • The Empire 880p is so new, the country's hi fi magazines have not had an opportunity to test and publish their opinions...in the meantime, here's what a happy new owner of the 880p wrote us recently: "Most musical, noise non-existent, the sound is transparent, spacious, airy, exceptionally musical, violins sound like violins not cellos or steel wires, in a class by itself" • The Empire 880p is the cartridge that renders every other cartridge on the market today obsolete • If you've read this far you are by all means a music lover most seriously interested in Highest quality record playback equipment. Above you have read a "few" of the reasons why we believe the Empire Troubador is for you. You've got the facts about the Empire 208 turntable, the Empire 980 Arm, and the Empire 880p Cartridge. But what about the integration of these three components? What about the system as a whole? • Every Empire component was designed and built for maximum integration with the Troubador system...no other manufacturer makes all three. You will never have a "matching" problem when you purchase all three Empire components • "High Fidelity" magazine said: "A precision-engineered product of the highest quality...in sum, the parts of the 'Troubador'—taken separately—stand up as first-rate audio components. Taken together, they form one of the finest and handsomest record players available" • "Audio" magazine said: "Precise in appearance and performance...as a system, the 'Troubador' Model 398 is not inexpensive [$222.50 including base], but it just reaffirms something we all know: higher quality means higher costs. The Model 398 is an excellent buy for those who want the quality" • To you determined readers we can only say that we rest our case. (sigh...now you don't have to write for our brochure...you've just read it).

Here are a few of the reasons why the EMPIRE TROUBADOR is called the "World's Most Perfect Record Playback System"

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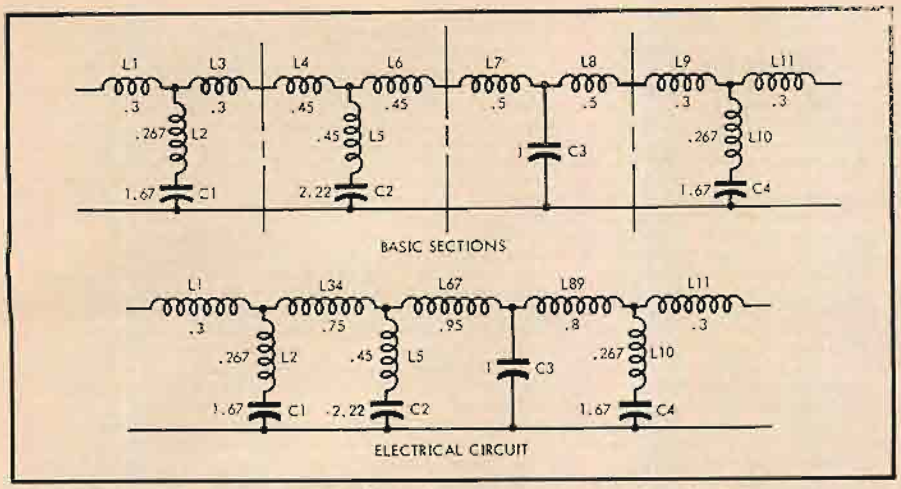


Fig. 5. Electrical derivation of the filter that was an early subject for experimentation in the use of leakage inductance.

primary, to maintain substantially the same main magnetic flux. It is the combined effect of these currents that produces the leakage flux, whose path takes the form shown at (B) or (C) of *Fig.* 1. Note that, where the main flux makes a loop round both coils entirely in the core, the leakage flux merely uses the core as a return path. Actually, the part of the coils not enclosed by the core (out in the air) also have just as much leakage flux passing between them. And whether in air or through the core, the return path has an infinitesimal part of the magnetic reluctance of that between the coils.

Compare the path between the coils with the magnetic air gap in a choke coil. A relatively small air gap can linearize the magnetizing characteristic considerably. The air gap dimensions are very short along the direction of the flux, and of area equal to the core itself, across the flux path. But the leakage flux path is many times the length of an air gap, at least an order of magnitude, while its area is very constrained in comparison. So the effect of the magnetic core as a return path can be ignored. Even the return path in air has negligible reluctance, compared to that between the coils.

In fact leakage inductance, as a circuit component, can be considered as linear as that of an air-cored coil. But its operating Q can be an order of magnitude greater than that of an air-cored coil of comparable size, and it has essentially no external field.

Leakage inductance is proportional to the leakage flux and to the number of turns in which this flux induces a voltage. At first viewing the leakage flux as being entirely concentrated in the very minute gap between the primary and secondary windings (usually only the thickness of a piece of insulating paper), the area occupied by the flux is this thickness multiplied by the length of the insulation as a wrap around the core. The length of the flux path increases its reluctance and thus reduces flux. This is the length of the interwinding space as shown on (B) or (C) of *Fig.* 1.

Note that the leakage inductance of arrangement (B) is several times that of arrangement (C) in *Fig.* 1.

Leakage flux is not entirely restricted to the interwinding space, as illustrated by *Fig.* 2. Starting at the left hand edge, outside of both windings, there is no leakage flux, and thus no voltage induction. As we progress through the primary (left hand) winding, we accumulate ampere turns of leakage magnetizing current, which reach a maximum at the interwinding space. As we progress through the secondary winding the magnetizing current ampere turns taper off linearly again, until at the far side we again reach zero.

Leakage flux density through the windings is proportional to the magnetizing current ampere turns inducing it. And the voltage the flux induces is proportional to the number of turns linked by each element of flux. This again is proportional to the distance from either outside of the windings. Integrating the effect of this flux distribution and its induced voltage, it is equivalent to a uniform flux equal to the density in the interwinding space, of one third the thickness of the windings, and linking all the turns.

So leakage inductance contains a factor consisting of the interwinding space plus one third of the total thickness of the two windings. Sectionalizing the windings by mixing, using the optimum distribution, reduces leakage inductance in proportion to the square of the effective number of sections.[1] Such techniques are used to minimize or optimize leakage inductance effects in normal transformer

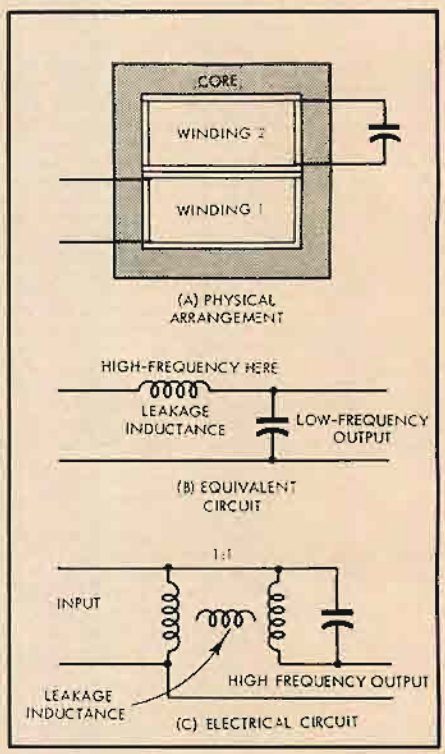


Fig. 7. Derivation of simple high-pass filter using leakage inductance.

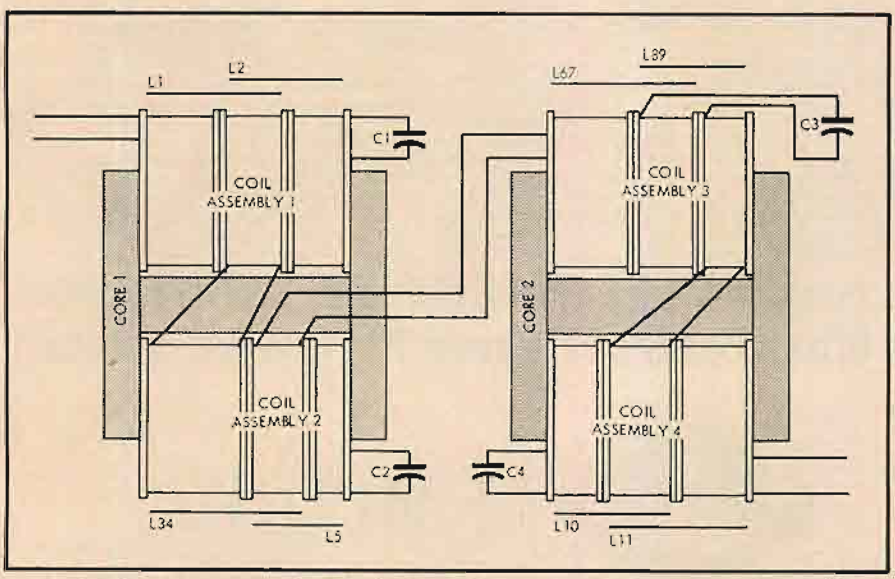
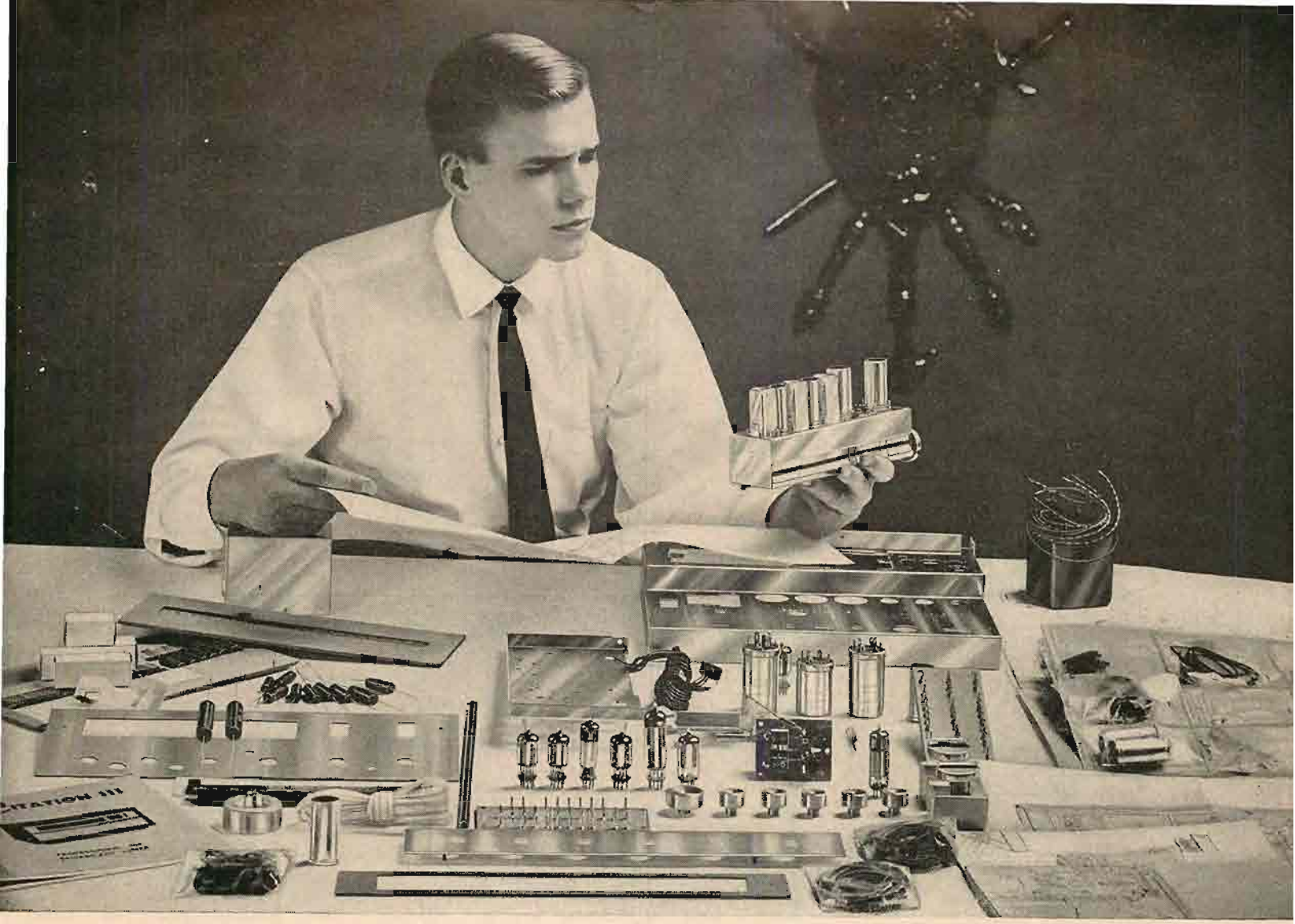


Fig. 6. Physical arrangement of the leakage inductance version of the filter of Fig. 5.



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Citation has the "specs" to back the claim but numbers alone can't tell the story. On its real measure, *the way it sounds,* Citation III is unsurpassed. And with good reason.

After years of intensive listening tests, Stew Hegeman, director of engineering of the Citation Kit Division, discovered that the performance of any instrument in the audible range is strongly influenced by its response in the non-audible range. Consistent with this basic design philosophy – the Citation III has a *frequency response three octaves above and below the normal range of hearing.* The result: unmeasurable distortion and the incomparable "Citation Sound."

The qualities that make Citation III the world's best FM tuner also make it the world's best FM/Multiplex tuner. The multiplex section has been engineered to provide wideband response, exceptional sensitivity and absolute oscillator stability. It mounts right on the chassis and the front panel accommodates the adapter controls.

What makes Citation III even *more* remarkable is that it can be built in 15 hours without reliance upon external equipment.

To meet the special requirements of Citation III, a new FM cartridge was developed which embodies every critical tuner element in one compact unit. It is completely assembled at the factory, totally shielded and perfectly aligned. With the cartridge as a standard and the two D'Arsonval tuning meters, the problem of IF alignment and oscillator adjustment are eliminated.

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For complete information on all Citation kits, including reprints of independent laboratory test reports, write Dept. A-12, Citation Kit Division, Harman-Kardon, Inc., Plainview, N. Y.

The Citation III FM tuner—kit, $149.95; wired, $229.95. The Citation III MA multiplex adapter—factory wired only, $79.95. The Citation III X integrated multiplex tuner — kit, $219.95, factory wired, $299.95. All prices slightly higher in the West.

The Citation III

Build the Very Best **CITATION KITS** *by* **harman kardon**

design. But here we are concerned with other ways of using leakage inductance.

Take a winding window whose dimensions are in a ratio of 3:1, which is typical of many transformer laminations. Division of the winding space as shown at (A) of *Fig.* 3 results in 9 times the leakage inductance of the arrangement of (B), using the same turns, and assuming the interwinding space is the same proportion of the total space in each case.

If we set out to divide winding space so as to give different leakage inductances between different pairs of wind-

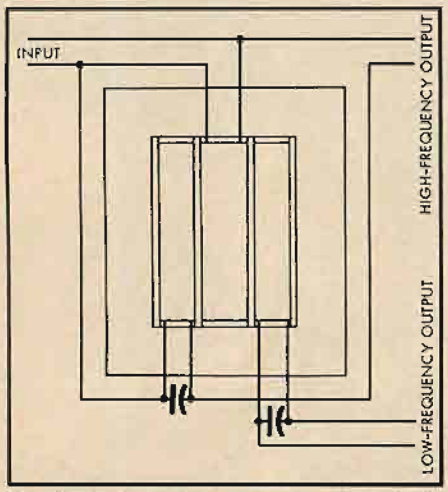

Fig. 8. Leakage inductance version of 12 db/octave crossover.

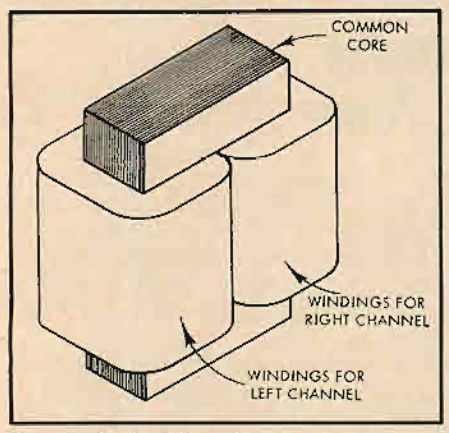

Fig. 9. Early idea for economy stereo output transformer.

ings, consider *Fig.* 4. At (A) we have three simple windings. The leakage inductance between windings 1 and 2 is half that of a pair fo windings whose total outline is square. The leakage inductance between windings 1 and 2 regarded as coupled together, and 3 is three times that of a pair of windings whose total outline is a square. So, referred to any specific number of turns in an individual winding, the leakage inductance between the combined 1 and 2 and winding 3 is 6 times that between windings 1 and 2 themeselves.

Now we intermix windings 1 and 2, as at (B) of *Fig.* 4. Note that in each of the arrangements, all three windings occupy

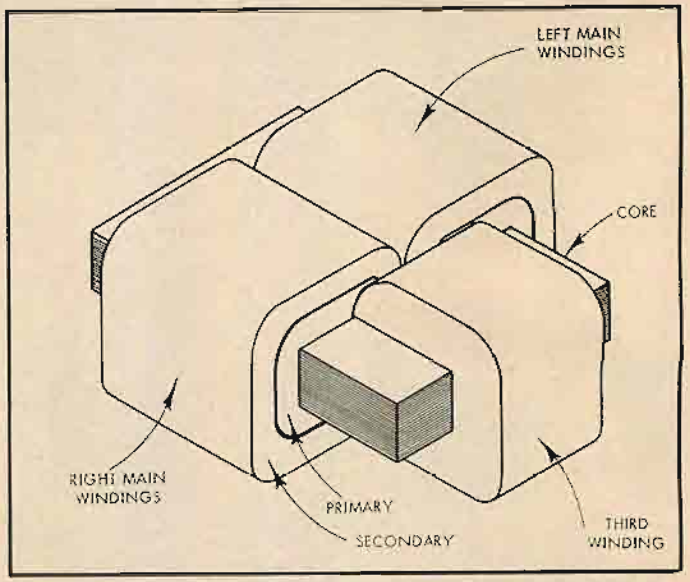

Fig. 10. A practical combined stereo output and crossover transformer.

equal cross section, which is sometimes a condition for maximum efficiency. With the intermixed arrangement, the leakage inductance is one-eighth of that between two simple (not intermixed) windings whose total outline is a square. So the ratio between the leakage inductances, referred to the same number of turns, is now 24:1. Almost any desired ratio can be figured by selection of appropriate geometry of the coil space.

Note also that the leakage inductance given by the higher figure is effectively that between either winding 1 or 2 and winding 3, due to the different arrangement, apart from the tighter coupling effected between 1 and 2, because of the distribution of the windings vertically (on the page). In the arrangement at (A), the disposition of either 1 or 2 relative to 3 has vertical asymmetry, so in addition to the leakage inductance due to flux paths running vertically, there will be a component due to some horizontal component of flux. This is negligible at (B) due to symmetry.

Filter Design

An early application of leakage inductance to filter design chose the m-derived circuit shown at *Fig.* 5. The top schematic shows the basic sections and the bottom one combines adjoining elements in adjacent sections into single inductance values, a practice followed in electrical filter design. This project[2] merely converted the same low-pass filter into leakage elements, and the physical form of the windings is shown at *Fig.* 6.

The ratio between L_1 and L_2 in the prototype is 0.3:0.267. So the total space marked L_1 and L_2 (note that the middle winding is part of each) in *Fig.* 6 has to conform to this ratio. If the number of turns on the left winding is such that L_1 is correct for a filter to match a 500-ohm circuit, this will be the input impedance of the filter. If we assume the interspaces are each one-twentieth of the total space, and the center winding is 0.3 of it, then solving for the remaining spaces gives the left as 0.344 and the right as 0.256, to give the correct inductance ratio.

The extreme right winding uses a number of turns such that C_1 can use a convenient capacitor value and refer the correct *effective* capacitance (by simple transformer action) into the circuit.

The middle winding uses any convenient number of turns to fill the space, because it merely has to couple to the bottom assembly left winding, whose turns can be selected to suit.

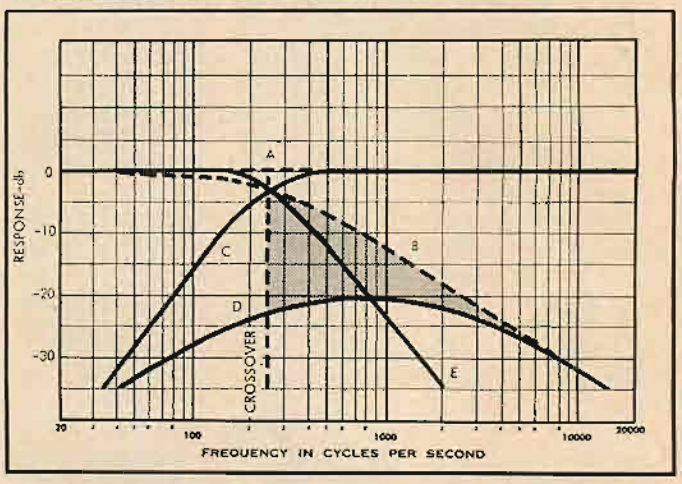

Fig. 11. Details of the performance advantages of the transformer of Fig. 10 (see text).

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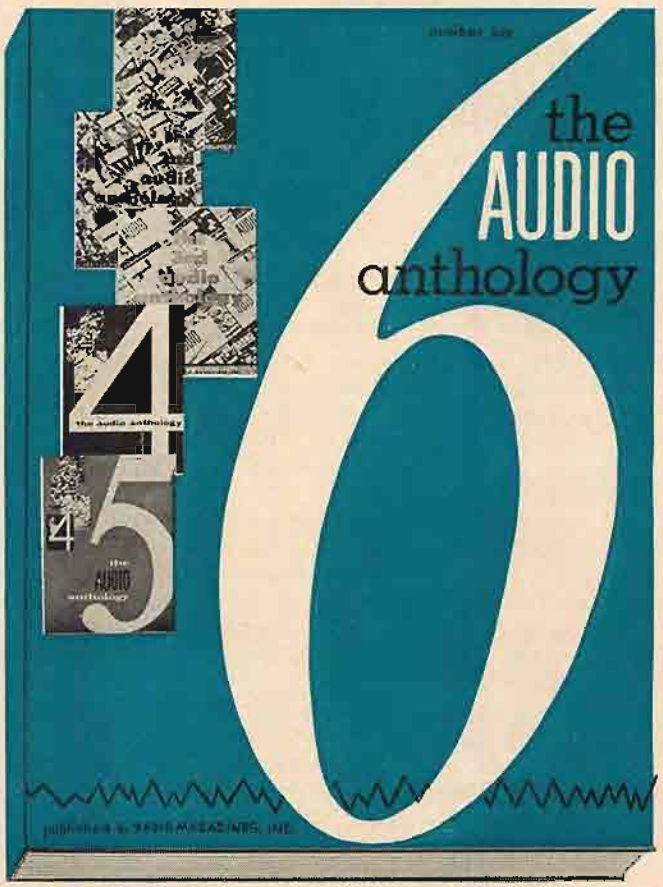

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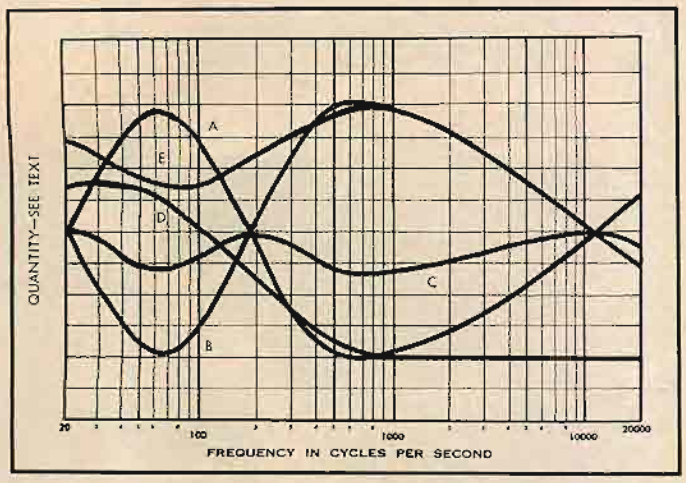


Fig. 12. Curves relating the amplifier to loudspeaker-matching problem.

In the bottom assembly, using the same technique, the proportions of total space work out to, 0.506 : 0.25 : 0 : 144, with 0.05 interwinding spaces. This gives the correct inductance ratio between L_{s4} and L_s.

As these two assemblies occupy similar spaces, actual inductance values must be matched by the ratio between the turns in the coupled windings, the middle top and bottom left. Based on the space ratios and inductance ratios (L_s and L_{s4}) the turns in the bottom left winding have to be the square root of 2.08 times those in the top middle, or 1.44 times.

This method is pursued through the design, so each inductance due to leakage is correctly referred, both by space ratio and turns reference to adjoining assemblies. If desired the output winding can again match 500 ohms, or it could equally well be designed to a high-impedance grid, without changing anything else. The windings to which capacitors are connected have numbers of turns that transform the actual capacitance used to that needed in the circuit.

By selecting a very compact capacitor from the available range, they may all have the same value, making a conveniently small package, fixed-frequency filter. Another design was developed, using a four-section tuning capacitor with solid dielectric, thus resulting in an extremely compact variable-frequency low-pass m-derived filter. Rejection at the points of "infinite attenuation" in the theoretical design was measured at better than 40 db, and the total volume of the filter approximated a 3-in. cube, to cover a cutoff range from 4000–15,000 cps.

Leakage inductance appears to be particularly adaptable to low-pass filter design in this way. The method for high pass was not immediately obvious. Note that a convenient feature of the low-pass type is one not obtained from its electrical prototype: electrical isolation between input and output circuits, like a transformer.

Figure 7 shows the development of the high-pass type. In the basic form shown here, it reverses the situation just observed for the low-pass. The electrical prototype gives d.c. isolation between input and output—the leakage inductance form does not. The operation of a leakage inductance high-pass filter can best be understood by considering the high-frequency output as being as a winding null in normal transformer action, and only getting output due to the presence of leakage inductance and other elements (the capacitor in this case) that invalidate simple transformer action.

With the exception that there is a low-frequency limit to the pass range, set by the operation of the filter cores as transformers, this high-pass filter works just as well as its electrical prototype. A simple two-winding arrangement, as at *Fig.* 7, can provide both low-frequency and high-frequency outputs, equivalent to a 6 db/octave crossover and in fact formed the basis of such a design.[3] In this case, each simple winding actually constituted a tightly coupled winding assembly, with multiple ratio tappings, to provide an extremely versatile experimental tool, capable of giving four different crossover frequencies, and as many push-pull input impedances and independent low-frequency and high-frequency load impedances. With this transformer it is possible to use a 15-ohm woofer with a 4-ohm tweeter, both correctly matched—or any other combination.

The basic arrangement for a 12 db/-octave filter is shown at *Fig.* 8. This is completely symmetrical, to give two identical leakage inductances, one used in the low-pass and one in the high-pass action. Separate capacitors are needed in this case.

Stereo Output Transformer

When stereo began as an experimental production entity, the possibility shown in *Fig.* 9 was suggested.[4] Its intention was for use in an inexpensive dual channel amplifier, where the d.c. magnetization of two single-ended output stages could cancel, push-pull fashion, and there would be loss of separation at the lower end of the range. To the best of our knowledge, this arrangement has not been used in this form.

However it led to the development of an improved version, shown in *Fig.* 10. This achieves a number of advantages.[5] As in the simple form of *Fig.* 9, the longer limbs carry a transformer each for left and right output, which can be single-ended just the same. But the end winding provides common low-frequency output, and uses a single shunt capacitor to complete the low-pass action in the feed to this unit. However adding this capacitor buys more than simple crossover action: it improves separation in the region immediately above crossover, as shown at *Fig.* 11.

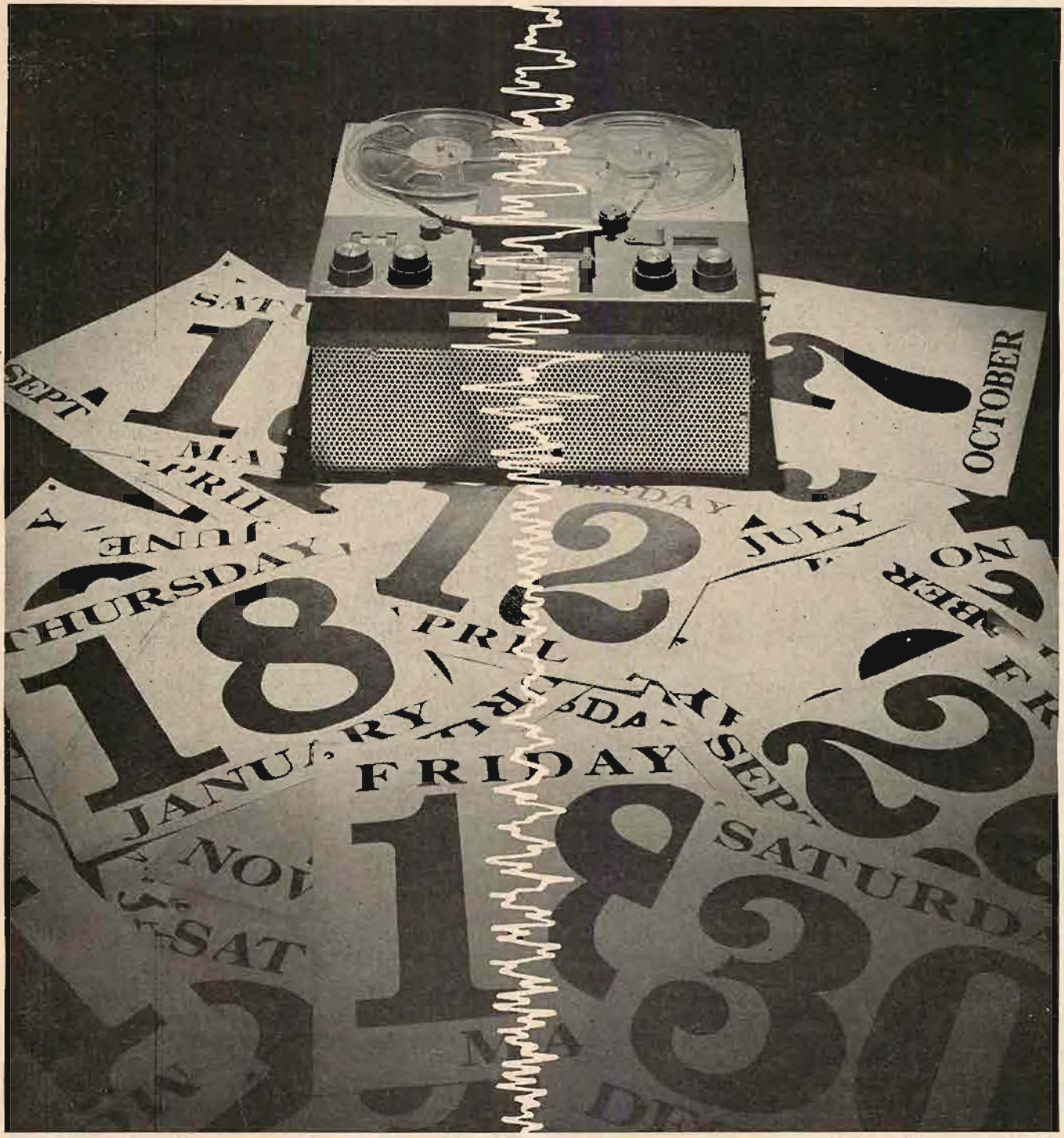
Curve (B) represents the separation obtainable with the simple two-winding assembly of *Fig.* 9. With the third winding and its associated capacitor, curve (A) represents each output response to its own winding and curve (E) represents the response into the low-pass output. Curve (C) represents the output into left and right outputs when differential turns from winding at the end are connected in series with the main secondary windings, while curve (D) shows the separation resulting in these outputs, due to a difference component (which starts as a sum, but is phase inverted in the third winding) from this combination. The shading shows the improved separation between left and right resulting from combined use of leakage inductance for crossover and left-and-right separation.

Amplifier-to-Loudspeaker Matching

The final audio use of leakage inductance we shall discuss here helps solve an old problem in an extremely simple way: amplifier to loudspeaker matching. *Fig.* 12 shows the pertinent points of the problem, as well as illustrating how this method solves it.

Curve (A) is the impedance curve of a typical dynamic loudspeaker. Fed from a true constant-current amplifier, this would also be the power available curve. But if a pentode is matched to the 600-cps value of impedance, the available power looks like curve (B), although the frequency response (measured as output voltage) may appear as curve (A). Using feedback may improve the frequency response, but it still leaves the available power as at curve (B). Using an impedance-matched transfer, where the source impedance is equal to a mid value of loudspeaker impedance, results in a frequency response, in terms of output power (not available power) of the form at curve (C), which is nearest to flat, but has a fractional damping factor and thus poor transient response. Also the available power response is still that of curve (B)—which is common for almost

(*Continued on page 58*)



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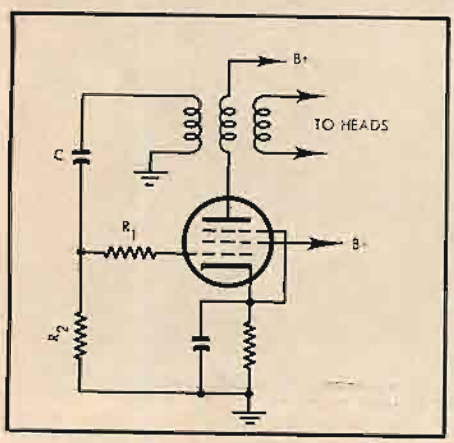
(Note: To facilitate a prompt reply, please enclose a stamped, self-addressed envelope with your question.)

Low-Frequency Mystery Solved?

In the January 1962 issue a reader raised a question about a "strange low-frequency sound," which appeared to be due to the oscillator. Several other readers have taken the trouble to give their views as to the cure of the trouble. J. H. Grobbelaar of 52 Chamberlain Road, East London, South Africa, has written the following:

"I recently investigated this low-frequency noise on a friend's recorder, and managed to cure it in the following manner: Most oscillators used for erase and bias have grid-leak bias on the grid. See the accompanying diagram of an oscillator (*Fig.* 1). The signal on the grid is large, and the grid is driven positive. The capacitor *C* charges, and the grid is biased negatively. If the grid current in this particular oscillator is too large, it may cause the grid to be driven so far negative as to



stop the action of the valve for a very short time. This is what appears as a 'plop' on the tape. If a resistor of great enough value is placed in series with the grid, it will limit the grid current. The charge on the grid-coupling capacitor is decreased and so is the bias on the grid. If R_1 in the diagram is large enough, the plopping should stop. I have solved the problem by replacing R_1 (which had a value of 1000 ohms) with a 2200-ohm resistor. The owner of the recorder has not complained since. I hope that this hint may help some experimenters to get rid of this annoying noise by trying different values for R_1."

Taping Old Phono Records

Q. I am trying to tape a collection of classical 78's recorded by celebrities of the last three decades, but unfortunately I cannot eliminate the excessive scratch and hiss, although I have tried everything to my knowledge. Slightly better results are obtained when I tape the records with one machine and copy this tape with a second machine. I have my audio preamp set to 78 equalization and the treble filter in the 9000-cps position when I copy the records. Your advice will be appreciated.

A. First, let me give a probable reason why you eliminate at least a slight amount of noise by retaping. Each time you record and play back at 7.5 ips, you get a sharp loss beyond 15,000 cps. Actually, the loss starts before 15,000 cps but is not pronounced on a single cycle of recording and playback. When you go through two such cycles, the treble loss prior to 15,000 cps starts to become significant. On the other hand, if you go through too many such cycles, you will pick up enough tape hiss to become objectionable.

The records you seek to copy probably do not have appreciable audio content above 7500 cps and perhaps not even above 5000 cps. Therefore you want to use very sharp filtering above 7500 cps or possibly above 5000 cps.

The treble cutoff filter in an audio preamp is generally located at a point beyond the tape output jack, so that it does not affect the signal fed to the tape recorder. The treble filter is effective only when you are playing back the tape. I suggest that, for one thing, you turn the filter switch to a cutoff frequency lower than 9000 cps.

To take advantage of the treble filter in recording you would have to obtain the signal from the regular output jack and feed this to the tape recorder.

A tape playback head makes an excellent sharp cutoff filter in the proper circumstances. Output of the head rises with frequency, eventually approaches a maximum, and beyond this maximum drops 25 db or more within one octave. The frequency of maximum response depends on two things: tape speed, and gap width of the playback head. By choosing a suitable tape speed and, if possible, a playback head with a suitable gap width, you can obtain very sharp cutoff action. As a first guess, it seems that if you employ the 3.75-ips speed and have a gap no narrower than 0.00025-in. (until 2 or 3 years ago most gaps were of this width or even wider, although modern heads now boast gaps of about 0.0001-in.) you can accomplish your purpose completely or substantially. The frequency at which the playback head has maximum response can be approximated by the formula $f = \frac{0.9S}{2G}$, where f is frequency, S is tape speed in inches per second, and *G* is gap width; the factor 0.9 allows for the typical difference between the physical gap width and the magnetic gap width (the latter, due to imperfections in head construction, is always somewhat greater). On the basis of tape speed of 3.75 ips and a 0.00025-in. gap, it may be calculated that *f* is 6750 cps. At this frequency there will be about 4 db loss in playback. At half an octave above this frequency (about 10,000 cps) there will be about 8 db loss. By 13,500 cps, response will be down 25 db or more.

On the other hand, if you play back at 3.75 ips with a modern head having a gap of about 0.0001 in. you won't obtain appreciable *playback* losses until about 16,000 cps.

However, you can get sharp treble losses in the recording process, provided that you record at 3.75 ips. These losses do not depend upon gap width, but upon magnetic phenomena associated with the tape. At 3.75 ips, the recording losses become quite enormous above 10,000 cps or thereabouts, much too great for treble equalization to cope with them successfully. If you increase bias current beyond the value recommended by the manufacturer, these treble losses incurred in recording become all the greater. Therefore, if you do not get enough treble cutoff by recording in the normal manner at 3.75 ips, you can further your purpose by increasing bias current. However, make sure you know what you are doing so that you can subsequently restore bias current to its normal value. Usually, this requires test instruments.

Before going to such lengths as substituting a 0.00025-in. playback head for a 0.0001-in. head and changing bias current, simply try recording and playing back at 3.75 ips, deriving the signal from the regular output jack of the audio preamp, with the treble filter set to a low cutoff frequency. By retaping, you can get additional noise reduction.

Taping Heartbeats

Q. Some writers claim that they can put heartbeats on tape. Does that call for a special microphone or the use of a special instrument?

A. I understand that Altec-Lansing makes a special microphone for the purpose of picking up heartbeats, which contain components of very low frequency. I suggest that for further information you write Altec-Lansing at 1515 South Manchester, Anaheim, California.

The tape recorder to be used in such an application should be capable of recording very low frequencies. This might require some slight changes, such as substituting coupling capacitors of larger value for those presently used in the tape machine. Attention would also have to be given to playback equalization, to make sure that bass boost is extended to the lower limit of the audible range. A number of tape machines do not provide complete equalization at the low end, enabling them to reduce the problem of hum in playback. Of course your tape machine should have a very low hum level to avoid interference with reproduction of the heartbeats.

Microphones

Q. I would like to buy a microphone with response plus and minus 2 db between 30 and 30,000 cps. Can you recommend something?

A. I doubt that you will find any model of any brand of microphone with such response. In a condenser microphone, if you are willing to spend about $300 to $400, you might find something with response flat within 2 db between 30 and 20,000 cps.

HE

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Series Feedback

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The classical formula for feedback conceals a factor which may lead to transient intermodulation, especially in transistor amplifiers.

$$\mu_f = \mu/(1-\mu\beta)$$

I AM UTTERLY BORED with this quotation which I have read and written countless times. It is not even completely true. These statements are calculated to attract the attention of the reader and to serve as a rather violent introduction to some consideration of the transient behavior of feedback amplifiers. Just how important the effects we shall be considering are in the actual use of amplifiers is rather difficult to assess because in general anyone who is seriously concerned with really high quality reproduction makes use of equipment which is never fully extended. This means that there is no need to examine critically the limitations of the equipment. The only thing is that this is not good engineering: the system should do what you want it to do and very little more. After all, you do not run a 10-ton truck just to bring the groceries home, although I'm sure there is at least one man in Detroit trying to do the equivalent for the 1964 models. We shall be facing the problem more seriously soon, as we try to get high fidelity in transistor amplifiers. It is going to hurt, because we moved up to decent quality with tubes by easy stages with the professional equipment leading the way: transistor amplifiers must come right up to our present standards at once if we are to take them seriously.

Transistor power amplifiers of the 10–20 watt class are not too difficult to design and build. The problem is achieving low distortion. Unless the transistors used in the output stage are extraordinarily expensive the designer is faced with a frequency cut-off somewhere in the range between 4000 and 10,000 cps. In general, the less power he asks for, the higher the limiting frequency. This limiting frequency dominates the whole design of the feedback loop and the over-all result is that we are forced to design transistor amplifiers very much nearer to the actual requirements because we must pay very much higher penalties for overdesign.

We must now consider what happens when we apply a large signal to a feedback amplifier. Since we are engineers we shall use a square-wave input to begin with but the implications of other waveforms will be examined later. We shall first of all disconnect the feedback so that we get from the input shown in (A) of *Fig.* 1 the output shown in (B).

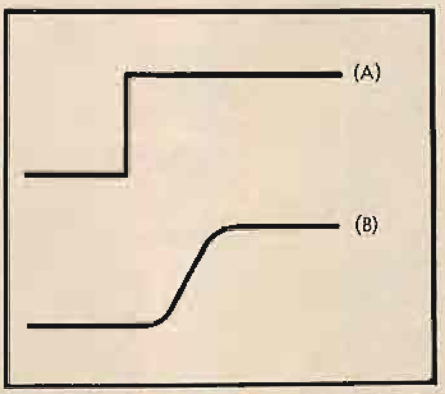

Fig. 1. The input square wave (A) is delayed and rounded off (B) before it reaches the output.

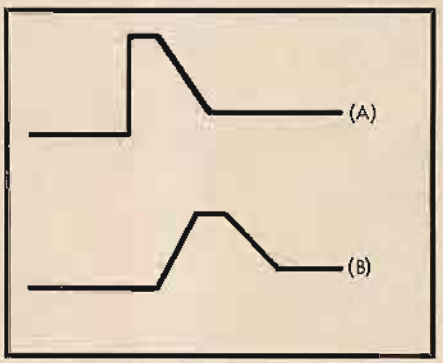

Fig. 2. As the initial signal goes through the amplifier and is fed back, the first passage results in an input (A) with a corresponding output (B).

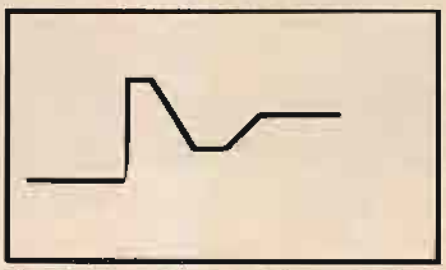

Fig. 3. When the signal shown in (B) of Fig. 2 gets through the feedback path (second time around) the total input has the form shown.

Because the amplifier has a limited bandwidth the output lags a little behind the input and does not rise instantly to its final value.

Now let us connect the feedback loop and let us assume that it has a completely flat frequency response. What we see in (B) is returned to the input, so that for this first trip the input will become something like the shape shown in (A) of *Fig.* 2 except that I have not rounded off the corners. If we were to have this waveform we should obtain the output shown in (B) of *Fig.* 2. But if this were the output, the input would be the combination of this (multiplied by the feedback coefficient (β) and the input of *Fig.* 1 and would look something like the waveform shown in *Fig.* 3.

I have carried this exercise through to the point where it reveals the basic characteristics which are developing. We see the growth of that characteristic ring which we often observe in carrying out square-wave tests on feedback amplifiers and I do not think it unreasonable to guess that if we went round the loop a few more times the number of oscillations in the ring would increase in proportion. We know that in amplifier design we can modify this ringing characteristic, usually by increasing the feedback at high frequencies so that any tendency to hump upwards in the overall frequency characteristic is controlled.

We see also that the feedback does not have any effect on the amplitude of the signal applied at the leading edge of the transient. It is a matter of detail whether the system later moves monotonically or by an oscillatory path to the final state: the leading edge is unaffected. What is more, this is a necessary condition for the amplifier to be stable. I do not propose to go through this in any detail but you will find it in Wiener's "Cybernetics" (M.I.T. Press and John Wiley). The analysis is for a perfectly general system which delays the input $f(t)$ to give an output of $f(t-\tau)$. In this t is restricted to being less than the value corresponding to *now* because no one knows what the signal is going to be in the future. By considering a pulse signal which comes out after a first travel as $a_1 f(t-\tau)$ and as $a_k f(t-\tau)$ after k times round the loop we can progress rapidly to a general function of the form

$$\int_0^\infty a(t)\ f(t-\tau)\,dt$$

What Wiener does now is convert this to a frequency plane characteristic plot and thus reach, in the end, what we call Nyquist's criterion for stability. For a feedback amplifier to be stable it must have this characteristic of relying on the past and it must rely on the past in a rather restricted way. The way we

(Continued on page 69)

David Izenzon is performing Scianni's **Horizon South**, written "for contrabass and electronic mutations."

contrabass with AR-3's

The AR-3 loudspeakers on stage at New York's Town Hall were chosen because they have a musical quality that makes them particularly suitable for working with the live instrument.

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A High-Quality Transistorized Stereo Preamplifier

ERHARD ASCHINGER

PART TWO OF A SERIES

The complete circuit of the stereo preamplifier is shown in *Fig.* 3. As already indicated, only EIA standard-value components are used throughout. Low-noise metal-film resistors are employed in the first stage circuit. To insure identical frequency response curves of the two stereo channels, 1 per cent components should be used in the frequency-determining feedback networks. Higher-tolerance elements may be used if they are selected for correct values. For the rest of the circuit 5 per cent components will adequately serve the purpose.

Very-large-value capacitors have been selected for the filter in the collector supply filter section to eliminate hum completely.

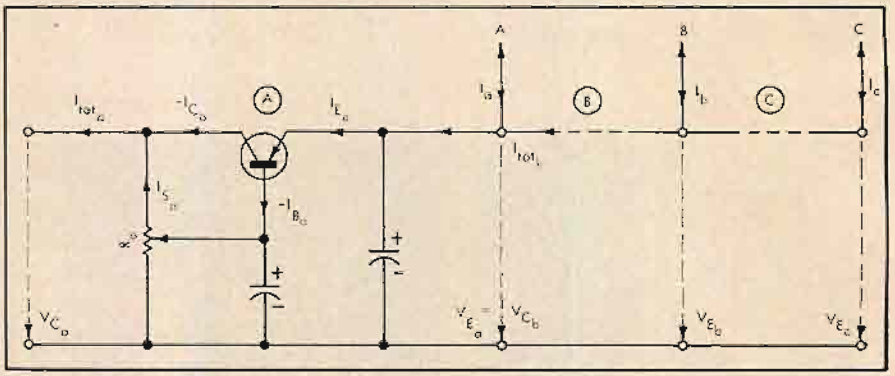


Fig. 4. Schematic of one low-pass filter element.

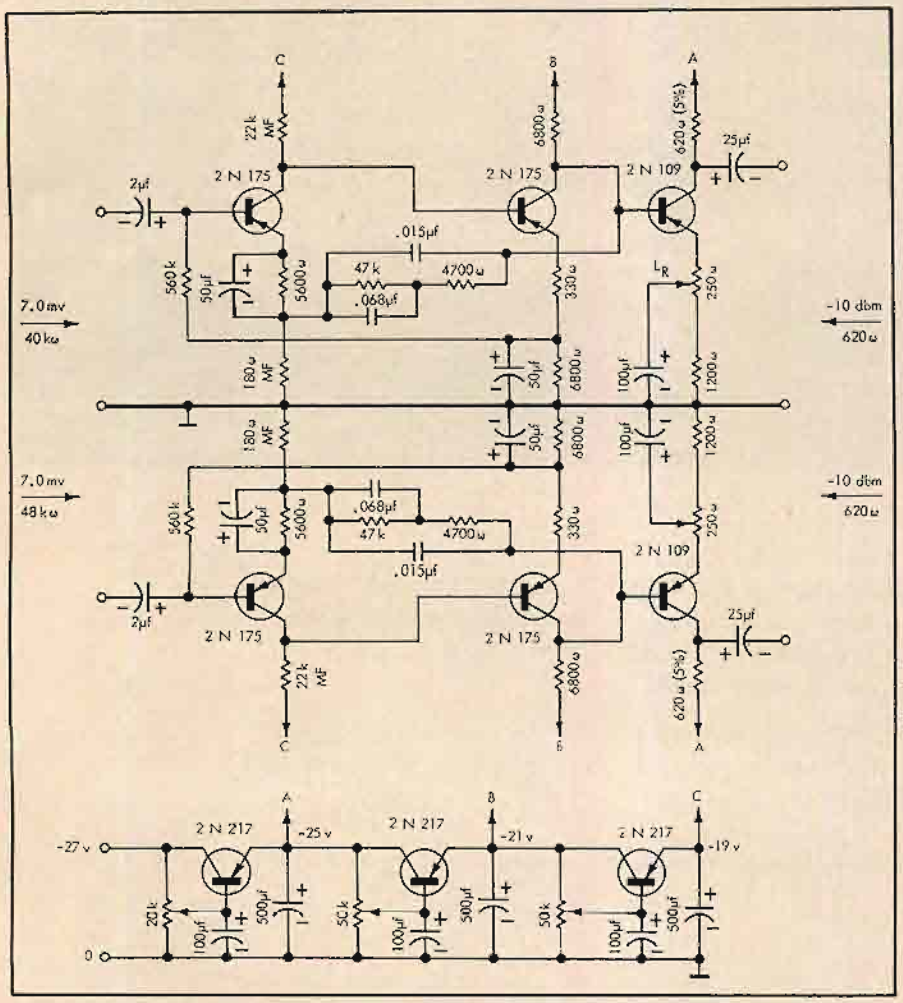


Fig. 3. Schematic of the stereo preamplifier.

The voltage gain of each amplifier section is adjusted to exactly 31 db at 1000 cps by means of the level controls, L_R and L_L.

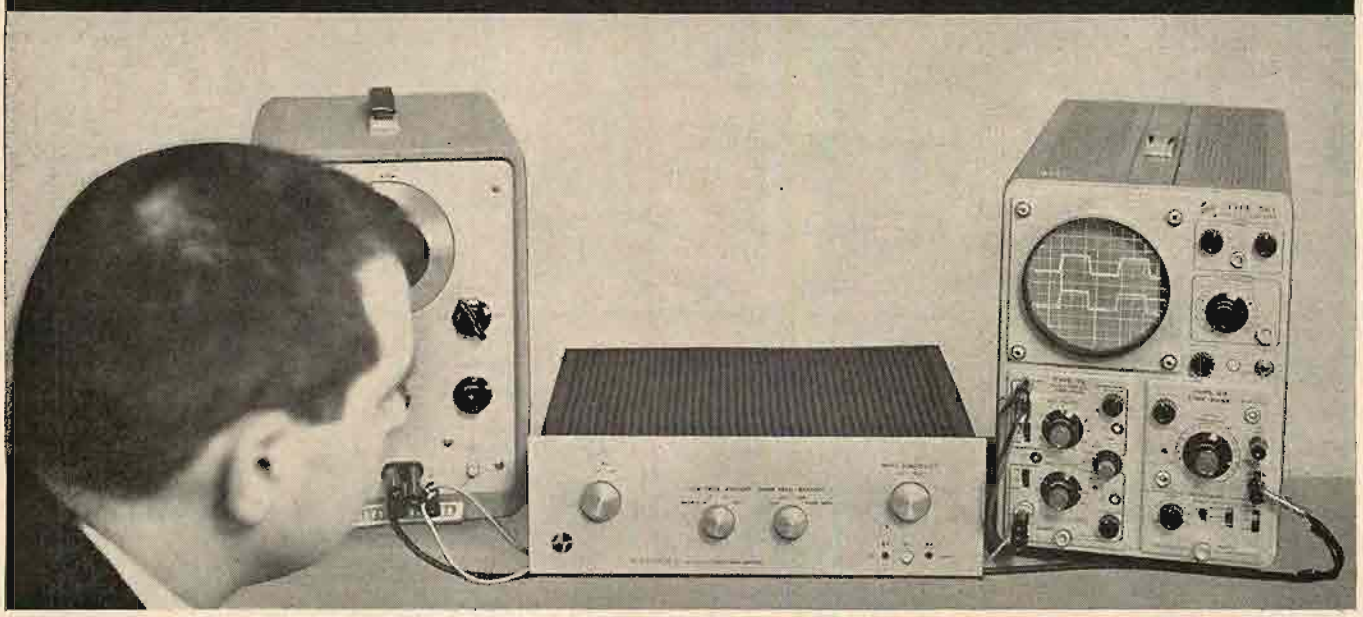
SUPPLY VOLTAGE RIPPLE FILTER

The preamplifier is powered by a transistorized regulated power supply with an output voltage of 27 v d.c. A special low-pass filter section provides for the different collector voltages required by the individual amplifier stages.

Instead of filter chokes, transistors have been employed as series elements in the filter circuit, since they are much smaller, cheaper, and completely insensitive to magnetic fields. The most important advantage of a transistor as a filter element, however, is, that its d.c. resistance may be adjusted to any desired value within a wide range, while its a.c. resistance is at least one order of magnitude higher.

Figure 4. shows the basic circuit arrangement of one element of the filter chain. The required operating point is obtained by applying constant-voltage bias to the base of the transistor by means of a voltage-divider potentiometer. Both collector supply and base bias voltages are well filtered by large-value capacitors. For adequate d.c. stability of the n-th filter element the relationship $I_{Sn} \geq 5\,|-I_{Bn}|$ must hold. Assuming that $-I_{Cn} \approx I_{En}$ and that the average d.c. current amplification factor of the

25,000 PEOPLE SEE UNPRECEDENTED DEMONSTRATION OF ACOUSTECH I—THE SOLID STATE STEREO POWER AMPLIFIER SOME SAID "COULDN'T BE BUILT"



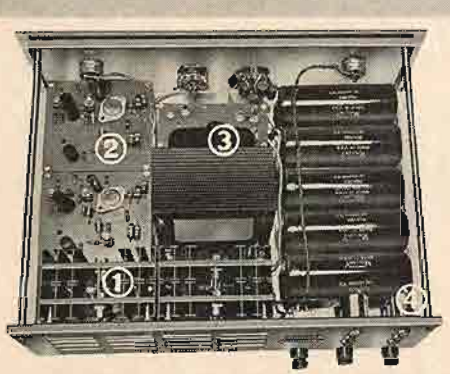
A fascinated audiophile at the 1962 New York hifi show observes the remarkable square wave response of the Acoustech I (the bottom pattern is the **20 KC** output of the square wave generator . . . the top wave is the output from the Acoustech I).

Acoustic Technology Laboratories introduces the first quality solid state stereo power amplifier — an amplifier capable of exceeding the most rigorous performance and reliability standards. Combining expensive all-silicon (Beta cutoff above one megacycle) output stages and direct coupled circuitry throughout (no output or driver transformers), the Acoustech I provides low distortion, high damping (better than 50:1) and superb transient response. This new standard of performance is accompanied by immunity to a variety of operating abuses . . . no load, capacitive load, shorted speaker leads and switching transients which can disable many vacuum tube amplifiers have no affect on the Acoustech I.

SOME INNOVATIONS OF ACOUSTECH I

(See illustration below)

1. SILICON OUTPUT TRANSISTORS IN PUSH-PULL PARALLEL CIRCUIT give extended response (Beta cutoff above one megacycle) for perfect reproduction of music transients. **2. HEAVY MIL-SPEC GLASS-EPOXY CIRCUIT BOARDS** for complete immunity to vibration and thermal changes. **3. MASSIVE, SHIELDED POWER SUPPLY** permits a guaranteed rating of 40 watts per channel *steady state with both channels operating simultaneously* (8 to 16 ohms, 20 to 20,000 cps). **4. GIRDER CONSTRUCTION, HEAVY GAGE ALUMINUM** found only in the most advanced scientific instrumentation.



MINIMUM SPECIFICATIONS: 40 watts per channel, rms, both channels operating simultaneously, delivered 8-16 ohms, 20-20,000 cps, with less than 0.95% harmonic and IM distortion (IM measured with 60 and 6000 cps tones mixes 4:1) at rated output; Rise time 1.75 μsec; Frequency response +¼, —1 db from 3.5 to 100,000 cps; Dimensions 15¾" w x 5" h x 12"; **$395** including cage (slightly higher West of Rockies).

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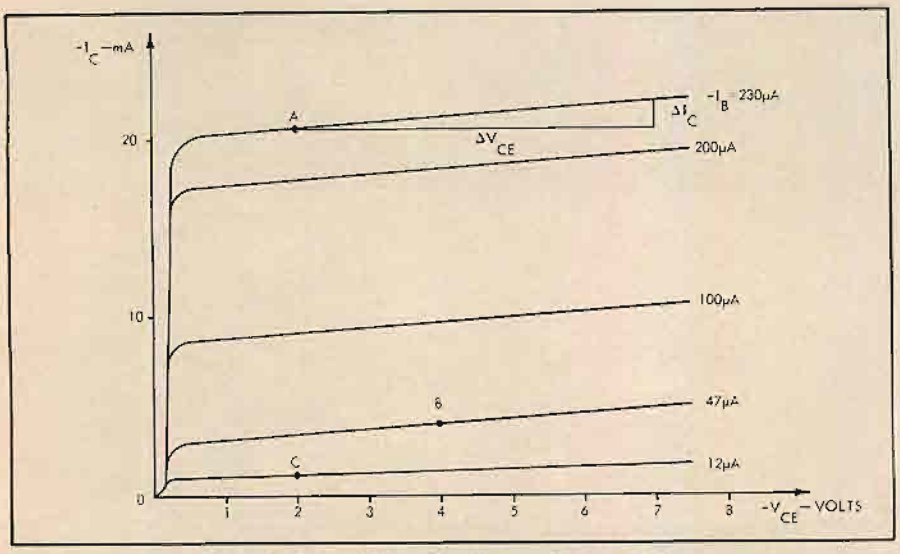

Fig. 5. Hitatchi 2N217 collector characteristics.

transistor type to be used is $\alpha_e = \frac{-I_C}{-I_B} \approx 85$ the maximum permissible resistance value of the base voltage divider may be determined with sufficient accuracy:

$$R_n \approx \frac{-V_{C\,n}}{I_{S\,n}};\ R_{n\,max} \approx 17\,\frac{-V_{C\,n}}{I_{E\,n}}\ [\text{v, A, ohms}]$$

The emitter current in the n-th element is $I_{E\,n} = I_n + I_{n+1}$, and its total current drain $I_{tot\,n} \approx \frac{-V_{C\,n}}{R_n} - I_{C\,n}$.

The collector supply voltage and current values required by the individual amplifier stages are shown in Table I. From this the operating points of the filter transistors and the resistance values of the base voltage dividers may be determined.

Element C :– $V_{C\,c} = 21.0$ v, – $V_{E\,c} = 19.0$ v, $I_{E\,c} = I_c = 1.0$ mA, $R_c \approx 17\frac{21}{1.0} \approx 356{,}000$ ohms. For increased stability a 50,000 ohm potentiometer will be used for R_c

$$I_{tot\,c} \approx \frac{21}{50} + 1.0 \approx 1.42\ \text{mA}$$

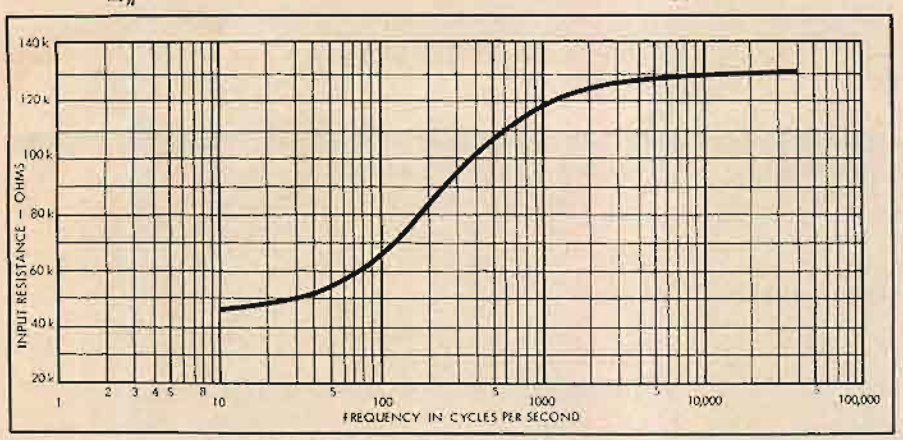

Fig. 6. Input resistance vs. frequency.

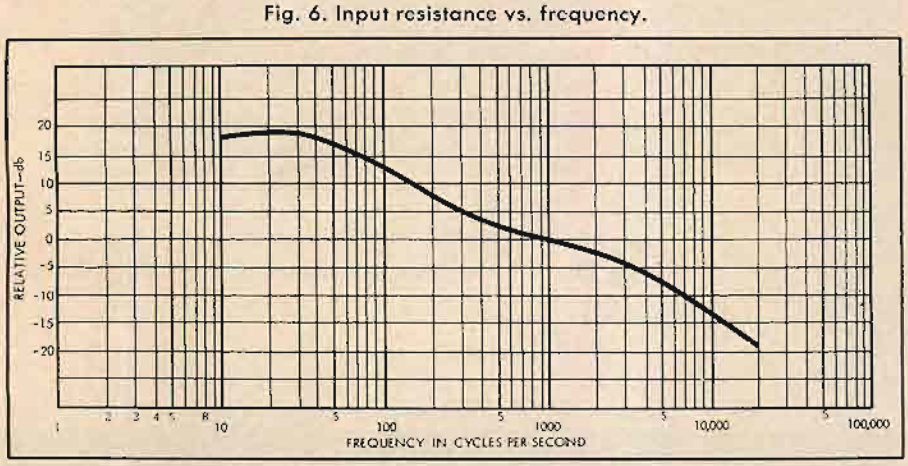

Fig. 7. Frequency response.

TABLE I

SUPPLY VOLTAGE AND CURRENT VALUES

Stage	– V_{cc} (volts)	I (mA)	Filter Circuit Terminal
1	19	1.0	C
2	21	2.6	B
3	25	16.0	A

Element B :– $V_{C\,b} = 25.0$ v, – $V_{E\,b} = 21.0$ v, $I_{E\,b} = 2.6 + 1.42 = 4.02$ mA, $R_b \approx 17\frac{25.0}{4.02} \approx 105{,}000$ ohms.

Again, a 50,000-ohm potentiometer will be used.

$$I_{tot\,b} \approx \frac{25}{50} + 4.02 \approx 4.52\ \text{mA}.$$

Element A :– $V_{C\,a} = 27.0$ v, – $V_{E\,a} = 25.0$ v, $I_{E\,a} = 16.0 + 4.52 = 20.52$ mA, $R_a \approx 17\frac{27}{20.52} \approx 22{,}400$ ohms.

Using a 20,000-ohm potentiometer, we get $I_{tot\,a} \approx \frac{27}{20} + 20.52 \approx 21.87$ mA.

Almost any general-purpose pnp transistor type may be employed in the filter circuit. For his own version of this unit the author selected Hitachi 2N217 transistors for all three filter stages. The maximum ratings of the 2N217 are: – $V_{CE} = 25$ v max, $I_C = 70$ mA max, $P_C = 150$ mW max at $t_{amb} = 25$ deg. C. The common-emitter d.c. current amplification factor is $\alpha_e \approx 85$.

The operating points of the individual filter stages according to the above calculations are shown in the collector characteristics of the 2N217, *Fig.* 5. From these, the a.c. and d.c. resistance values of the filter transistors may be determined. According to the position of the operating point the d.c. resistance of a stage is $R_{DC} = \frac{-V_{CE}}{-I_C}$.

The a.c. resistance can be determined from the slope of the collector characteristic in the operating point, since this represents the collector-to-emitter admittance $h_{22} = \frac{\delta I_C}{\delta V_{CE}} I_B = \text{constant}$.

Replacing the characteristic curve by its tangent in the operating point, we get

$$R_{AC} = \frac{\Delta V_{CE}}{\Delta I_C}.$$

The resistance values thus determined are:

A: $R_{DC} \approx \frac{2.0}{20.52} \times 10^3 \approx 97.5$ ohms

$R_{AC} \approx \frac{5.0}{1.5} \times 10^3 \approx 3300$ ohms

B: $R_{DC} \approx 995$ ohms

$R_{AC} \approx 3800$ ohms

C: $R_{DC} \approx 2000$ ohms

$R_{AC} \approx 9000$ ohms

It can be seen that the a.c. resistance

(*Continued on page 70*)

bzzzz

When a very small boy has his hair cut, the clippers make a harsh buzz—a nervous, exciting sound. Yet the same machine gives off only a dull hum when it's used on a man.

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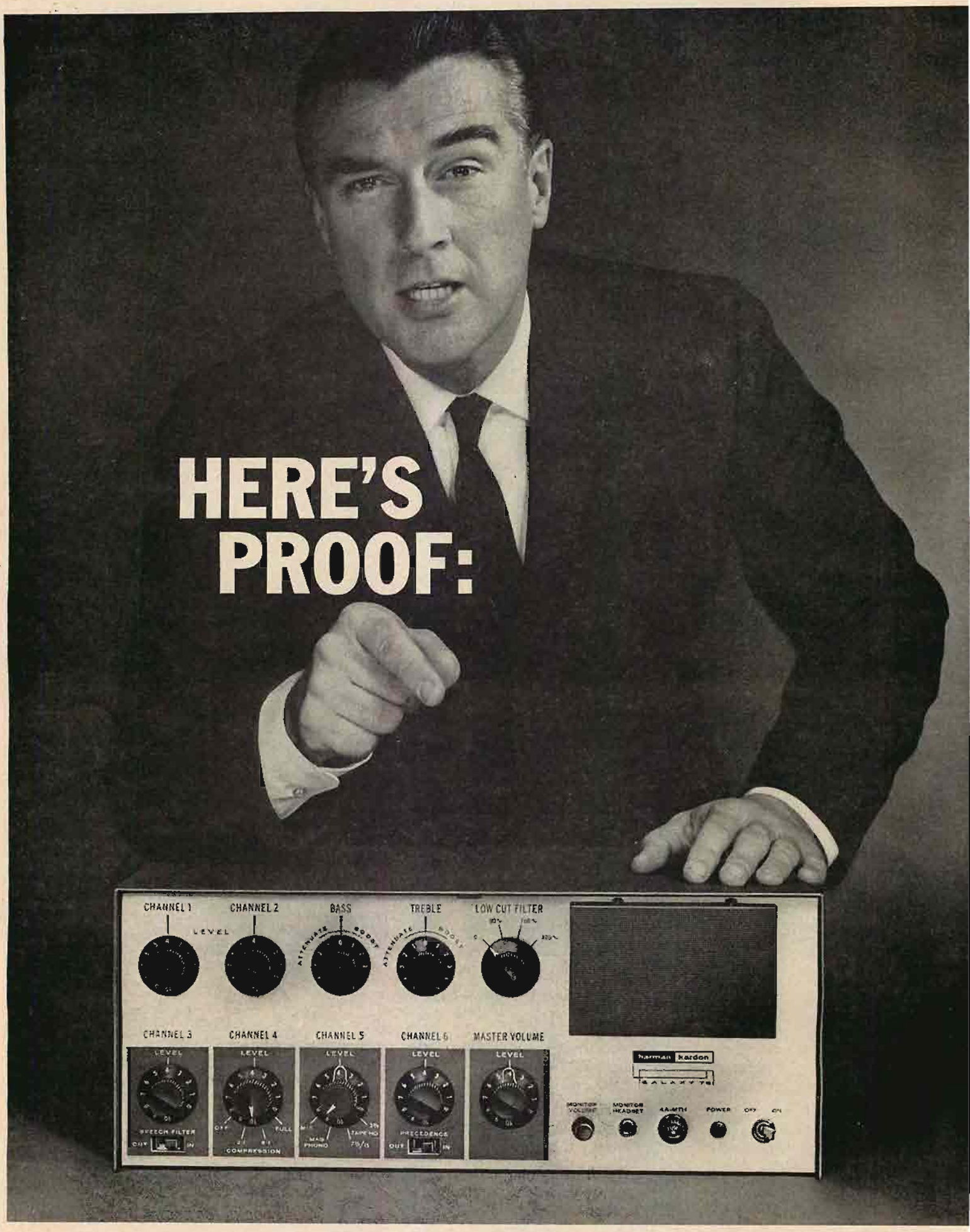

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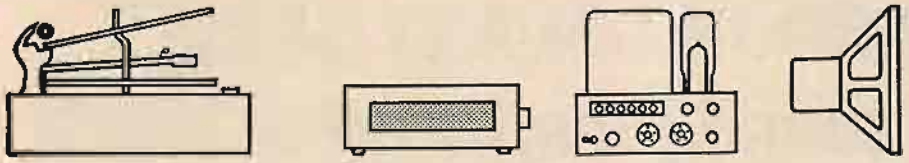

DUAL STEREO TAPE RECORDER, MODEL TG12SK

Dual of West Germany, which has won acclaim for its record changer, has recently introduced into this country a stereo quarter-track tape recorder calculated to uphold the company's reputation and make audiofans take notice. Compact, and quietly attractive in appearance, it has most of the features the serious home recordist is apt to need, plus performance that, over-all, places it in the select category of home tape recorders consistent with high fidelity. It can record and play stereo in two directions of four mono tracks.

Rarely if ever does a new product make a perfect score on its intial appearance, particularly a product as complex as a tape machine. Dual is almost an exception to this rule. We do have three criticisms which we will talk about later. It should be noted that our unit was apparently one of the first off the production line and subsequent units may be immune from these criticisms.

The Machine

The Dual has a single motor, with rubber belts driving the capstan and the reels. A single record-playback head is used so that it is not possible to monitor the tape while recording. This is the only design departure from customary professional practice. The erase head has dual gaps (four gaps in all, since it is a stereo head) for improved erasure. The machine operates at 7.5, 3.75, and 1.875 ips, shuts off automatically when the tape runs out or breaks, has a 3-digit footage counter, is equipped with an EM84 magic eye indicator (two bars that come together at maximum permissible recording level) covering a substantial range of about 20 db, and has perfectly straight in-line loading that enables the tape to be inserted or removed with complete ease.

Operating modes are controlled by seven pushbuttons: fast rewind, fast forward, start, stop, playback, microphone-record, and radio-record. All except the last two buttons are pleasantly easy to push down; the action is gentle but positive. Considerably more effort is required to depress the two record buttons; the designers have done this deliberately to reduce the chance that the operator will accidentally put the machine in the record mode, which might spoil a valued tape. Furthermore, the record buttons cannot be depressed unless the stop button is simultaneously in the down position.

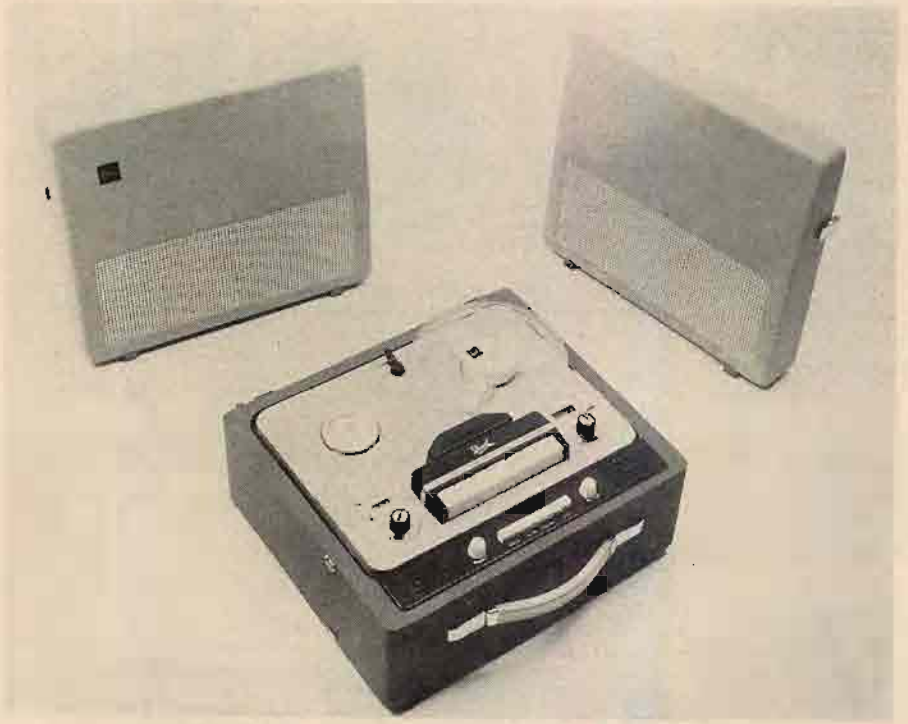

Fig. 1. Dual stereo tape recorder, Model TG12SK.

A "track selector" switch governs the choice between mono and stereo operation. The switch has three positions: stereo, 1, and 2. In stereo position, both gaps of the record-playback head are employed for recording or playback. In position 1, only the upper gap is activated and is connected to both input channels during recording or both output channels in playback. In position 2, only the lower gap is employed and is connected to both channels. The erase head, of course activated only in recording, has both of its dual-gaps operating in stereo position, and either the upper or lower dual-gap operating in position 1 or 2.

The Dual has not only the customary top cover but also a bottom one, each containing a speaker; naturally, both covers are removable. Hence the Dual constitutes a fully self-contained recording and playback system with complete portability. The sound of the speakers is relatively good—reasonably smooth and well-balanced. When recording, the incoming sound can be monitored through the speakers. Speaker volume can be balanced through a balance control. A set of four pushbuttons provides equalization of the signal fed to the speakers but has no effect on the frequency response of the signal being recorded or of the playback signal fed to an external audio system. The equalization buttons are marked "orchestra," which gives nominally flat acoustic response; "bass," which gives very pronounced bass emphasis down to about 100 cps, but not lower in order to avoid injury to the small speakers; "low," which sharply attenuates the highs: and "jazz," which sharply accentuates the highs.

The Dual does not permit true sound-on-sound recording. This requires two things: 1. That a machine be able to record on one track while playing back the other; 2. that a machine be able to record simultaneously from a microphone and from a high-level source. The Dual can do neither. However, it permits something akin to sound-on-sound by means of a key labeled "trick" and described in the instructions as a "stereo dubbing key." With the machine in the playback mode, and the trick key in the down position, you can push the record buttons without activating the erase head. Accordingly, you can superimpose a new recording on the tape without erasing the prior recording. However, we found that the level of the first recording was appreciably reduced when the second recording was superimposed.

Separate gain controls are provided for recording and playback. The recording control operates on both channels simultaneously. So does the playback control, which affects only the signals going to the self-contained speakers; the output signals to an external system are unaffected. These signals are about 2.5 volts, when the tape has been recorded at maximum permissible level, which is enough to drive any preamp or power amplifier.

Input and output jacks are of the European type, which resemble the Cannon jacks employed in U.S. professional equipment. There are three input jacks, marked radio, microphone, and phono. When the record button marked radio is pushed down, this feeds the signal from both the radio and phono jacks into the record amplifier (accordingly, there is a mixing facility of a crude sort, but one then faces the problem of the two sources loading each other, with possible deleterious effects in terms of distortion and frequency response). The microphone input provides adequate gain for a signal as low as 2 mv. Curiously, the radio input does the same. The phono input, however, requires a signal of about 0.1 volt. The radio input provides a load impedance of 22,000 ohms, while the phono

MODEL 780 FM Multiplex Stereo Tuner. The ultimate instrument for receiving FM and FM Multiplex Stereo broadcasts. Contains PILOT's revolutionary signal sampling Multiplex circuit for perfect FM stereo channel separation (better than 30 db) across the entire audio spectrum. Features PILOT's exclusive Automatic FM Stereo Indicator that eliminates all guesswork in finding FM Stereo broadcasts. FM sensitivity (IHFM): 1.8 microvolts; capture ratio: 1 db; frequency response (±1 db): 20-20,000 cps; FM detector bandwidth: 800 kc; FM IF stages: four; harmonic distortion 0.2% at 100% modulation. Has built-in line cord FM antenna plus terminals for external 300-ohm balanced antenna and 72-ohm coaxial cable. 199.50, less enclosure (metal enclosure: 9.50 extra; walnut enclosure: 22.50 extra).

MODEL 248B Integrated Stereo Amplifier. A 74-watt stereophonic amplifier-preamplifier that takes up where others leave off. Only 0.1% harmonic distortion (IHFM); frequency response (±1 db): 5-50,000 cps; hum and noise: completely inaudible (80 db below full output). Speaker outputs per channel: 4, 8 and 16 ohms plus STEREO-PLUS CURTAIN OF SOUND connections (a pair of center speaker connections delivering a signal that is the sum of Channel A and B). Outputs for tape and headphones. 7 pairs of inputs. A total of 13 front and back controls and switches including separate bass and treble controls, scratch and rumble filters, stereo balance, tape monitor, mode and automatic shutoff. 269.50, less enclosure (metal enclosure: 9.50 extra; walnut enclosure: 22.50 extra).

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for more information, hear them.

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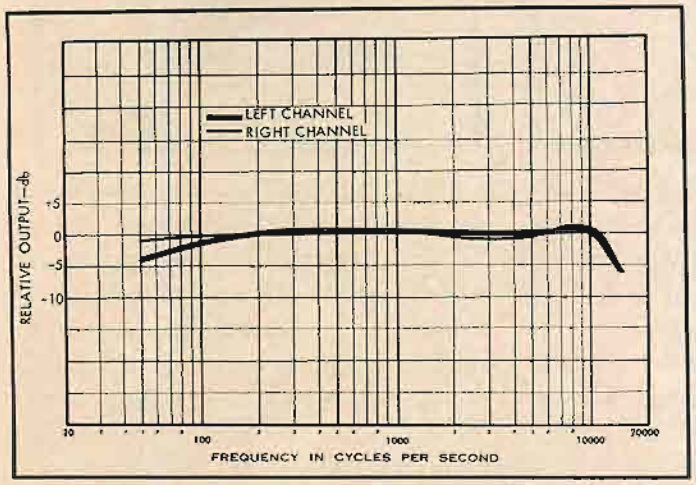

Fig. 2. Record-playback response at 7.5 ips with 1000 cps as 0-db reference.

input provides a 1-megohm load. Accordingly, the high-level signal from the tape out jack of the preamp, from a tuner, and soon should be connected to the phono rather than radio input. Apparently the Dual is geared to European rather than U.S. practices.

The output impedance is fairly low, about 20,000 ohms, permitting up to about 10 feet of low-capacitance cable (25 to 30 pf per foot) to be used without significant treble loss. Hence the Dual can be located, if need be, a fair distance from an external audio system to which it supplies a playback signal.

The electronic circuitry is quite straightforward and only a few comments are warranted. In each channel, a.c. is used on all tube filaments except an EF86, which is employed as the first stage both in recording and playback: d.c. is used here. Although high-quality tape recorders customarily employ two triode halves as a push-pull oscillator, in order to minimize even-order harmonic distortion and thereby decrease noise produced in recording, the Dual uses a single pentode. The power output stages, which drive the self-contained speakers, are single-ended, but feedback is used to reduce distortion.

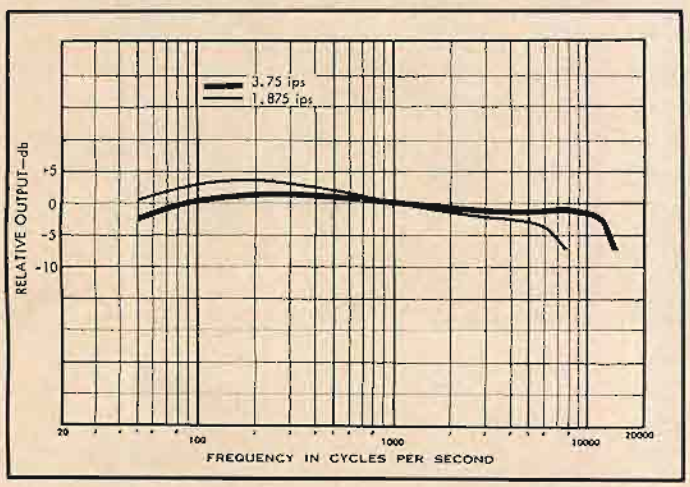

Fig. 3. Record-playback response at 3.75 and 1.875 ips.

Measurements

At 7.5 ips. record-playback frequency response measured flat within 1 db between 50 and 12,000 cps on the right channel, and between 100 and 12,000 cycles on the left channel. Although response was 4 db down at 50 cps on the left channel, this is within NAB professional specifications. Both channels were 6 db down at 15,000 cps; NAB permits response to be down 4 db. *Figure* 2 shows the measured results on the record-playback test at 7.5 ips, with 1000 cps as the 0-db reference.

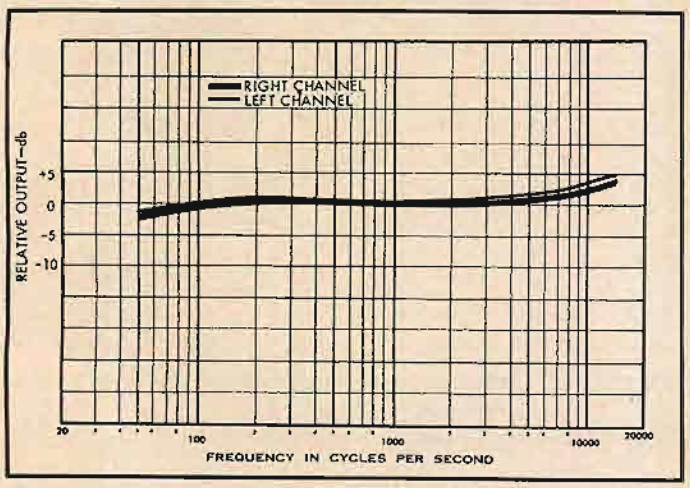

Fig. 4. Playback reponse at 7.5 ips using Ampex test tape No. 31321-01.

In view of the very substantial similarity between channels, record-playback response was measured only on the left channel at 3.75 and 1.875 ips. Remarkably good results were obtained at 3.75 ips, and allowing for the problems incurred when tape speed is once more cut in half, nearly the same can be said for 1.875 ips as shown in *Fig.* 2.

Using Ampex Test Tape 31321–01, measurement of playback response at 7.5 ips showed it to be essentially flat to 7500 cps, with a mild rise beyond that point, as noted earlier in this review. At 15,000 cps, response was plus 4 db on the left channel and plus 5 db on the right channel, (see *Fig.* 4) deviations that could easily be compensated with a slight touchup of the treble control in an external audio system.

Measurement of signal-to-noise ratio, which generally yields uninspiring results in most home tape recorders, produced exceptional results in the case of the Dual. Including noise produced in recording as well as playback, the signal-to-noise measured about 55 db at 7.5 ips, about 53 db at 3.75 ips, and 51 db at 1.875 ips; this measurement was based upon a 400-cps tone recorded at a level producing 3 per cent harmonic distortion on the tape. It is interesting to note that in its specifications the Dual modestly claims a signal-to-noise ratio of only 46, 45, and 42 db at the three respective speeds; apparently this is based on a recording level 10 db below the maximum permissible level.

Signal-to-noise ratio was also measured at 7.5 ips on the basis of noise produced only in playback, which is the principal limitation in most home tape recorders. When the tape was not in motion, we measured about 60 db. The ratio dropped 1 or 2 db with the tape in motion, which means that tape noise (the tape had previously been carefully bulk-erased) is the limiting factor for this machine so far as playback noise is concerned.

Accordingly, noise produced by the Dual occurs chiefly in recording. For some reason that the reviewer did not fathom, the Dual picks up a slight amount of 60-cps hum in recording, and this hum slowly increases and decreases in magnitude; at its low point, record-playback signal-to-noise at 7.5 ips measured about 59 db; at its high point, record-playback signal-to-noise measured about 51 db; hence it averaged 55 db at 7.5 ips.

According to the specifications, one gathers that magic eye closure corresponds to 5 per cent harmonic distortion recorded on the tape. Measurement, however, showed that closure corresponds to 3 per cent distortion, which is as it should be for high-quality recording.

It was stated earlier that the erase head has dual gaps. Better than 50-db erasure was achieved of a 400-cps signal recorded at a level producing 3 per cent harmonic distortion; the remaining sound was slightly audible. At 1000 cps, over 55 db of erasure was achieved, and the remaining sound was completely inaudible. On the other hand, below 400 cps erasing efficiency dropped. Therefore the serious recordist is well, advised, with any machine, to subject the tape to a bulk eraser before committing a valued recording to it.

One criticism of those we mentioned before, concerns tape speed. At 7.5 ips, speed measured about 4 per cent fast, which may be noticed by a musical ear when playing

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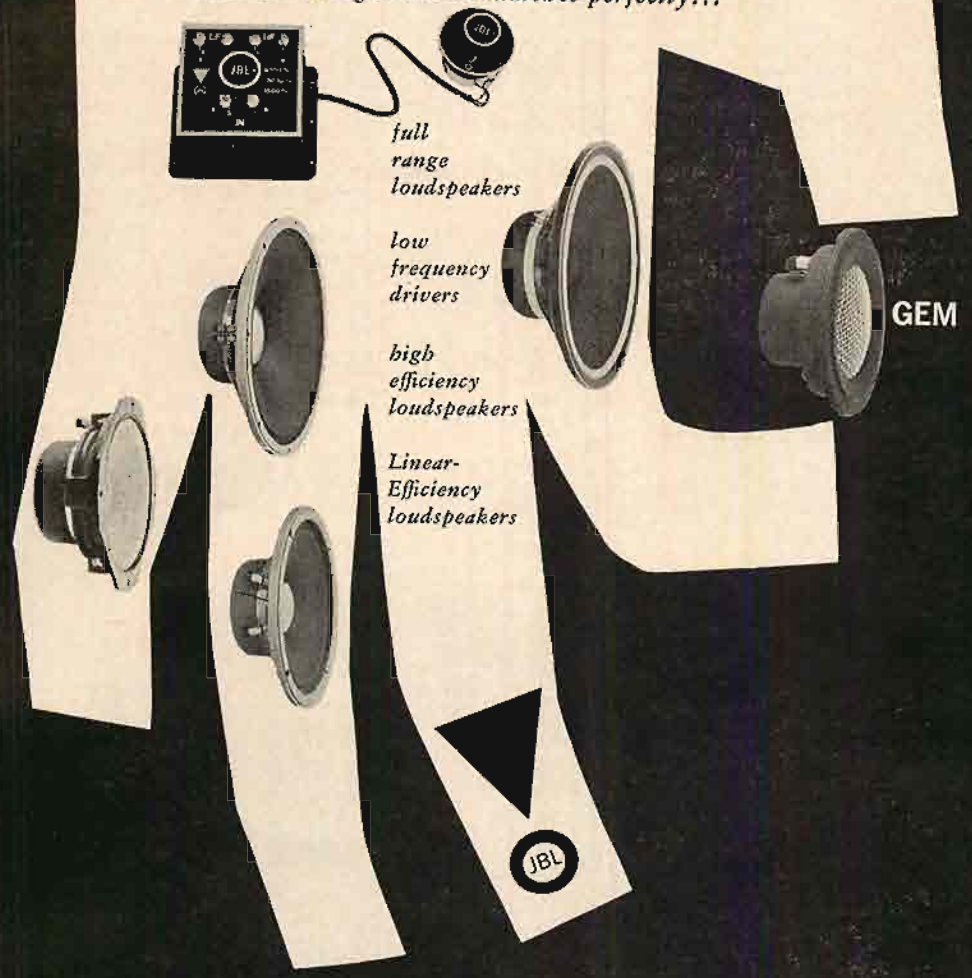

GEM OF VERSATILITY

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JAMES B. LANSING SOUND, INC. JBL **LOS ANGELES 39, CALIFORNIA**

prerecorded tape. The measurement was made with the power transformer, which has a variable primary tap, set for 110 volts a.c. When set for 125 volts, speed was about 3 per cent fast. Possibly when the machine has been used for a period of time it will slow down to more nearly correct speed.

Another criticism concerns slightly excessive treble response when playing a prerecorded tape. However, the excess occurs mainly above 10,000 cps; more about this later. The other minor criticism concerns the spindle holding the supply reel. After several hours of use, the spindle crumbled off in the fast forward mode. Of course this made the machine inoperative. From the nature of the break, and some experience with this tape of plastic, we would guess that the spindle had been damaged in transit and didn't reveal the fault until we started to use it.

Motion was tested by recording and playing back a 3000-cps tone. At 7.5 ips, motion appeared excellent both to the ear and as viewed on an oilloscope; the sound was very steady, clear, and pure; it was hard to detect any pulsing. At 3.75 ips motion appeared fairly good, with pulsing noticeable. Motion was fair at 1.875 ips.

The Dual handles tape excellently, going from fast forward to fast rewind without spilling or jerking the tape. It starts up immediately, with very little tape bounce—noticeable on a steady tone but not on program material. Both fast forward and rewind times for a 1200 ft reel of tape measured slightly over 90 seconds, which is fairly typical for home machines. In each fast mode, a fairly smooth wind was obtained. During normal operation (play or record) a very smooth wind was obtained. The machine is quiet mechanically. Really the only mechanical noise one hears is the tape brushing past the guides and heads.

No pressure pads are employed. In this desirable respect the Dual is very unusual among home machines, particularly in its price class. Intimate contact between the tape and the record-playback head is achieved by means of a hum shield that is brought toward the head (without touching it) during the record of play mode. The shield has a metal flange at each end that pushes the tape slightly past the front of head. The distance between the flanges is somewhat greater than the width of the head. Contact between the tape and the erase head is achieved by means of a tape guide, orientation of the head, and the path followed by the tape. During fast forward and rewind, the tape is lifted away from the record-playback head, but does brush against a corner of the erase head. Whether this causes significant head wear was not checkable in our relatively brief tests, but seemed rather doubtful.

In the final analysis the Dual TG12SK is really an excellent machine for the home recordist and should be seriously considered when a purchase of a tape machine in this category is contemplated. **M-21**

LAFAYETTE VTVM KIT, MODEL KT-174

The Lafayette KT-174 is an a.c. VTVM combined with the functions of a VOM to provide a very useful instrument in a compact package and price. The type of measurements possible with this instrument include: d.c. volts in seven ranges up to a maximum of 1500 volts; low a.c. volts rms in three ranges up to 0.5 volts; low a.c. volts peak-to-peak in three ranges up to 1.4 volts; a.c. volts rms in seven ranges up to 1500 volts; a.c. volts peak-to-peak in seven ranges up to 4200 volts; ohms in seven ranges up to 1000 megohms; and zero-center indication in seven ranges from ±0.75 volts up to ±750 volts.

Some of the useful features of the instrument are the large meter face, the easy accessibility of the calibrating potentiometers (all on the rear apron), and the use of a convenient probe with built-in a.c.-d.c. switch. Two jacks are provided at the rear panel which are connected internally to the input to the VTVM thus permitting an oscilloscope to be connected for waveform observation during a.c. measurements. The audiofan will especially appreciate those terminals because it will make his task easier in most of his testing and aligning. In addition his burden will be eased by the zero center indication which will come in handy for some bias adjustments and FM discriminator alignment.

Circuit Description

The heart of the KT-174 is a 12AU7 in a bridge configuration with a 200-μa meter connected between the plates of the twin triode. The two tube sections are balanced for equal plate voltages with no input signal by means of the BRIDGE BAL control. When a positive voltage is applied to the first grid the current through that tube section is increased, as is the current through the common cathode resistor, causing a decrease in plate voltage of the first section and an increase in the second. The potential difference between plates causes current to flow through the meter. This procedure for obtaining meter indication, applying a d.c. voltage to the grid of the first tube section, is used in all functions. Since full-scale meter deflection is obtained with 1.35 volts, this amount is the maximum permitted to enter the bridge circuit. A voltage divider, essentially consisting of a number of resistors in series, is provided to make sure that the maximum input in each range develops a maximum of 1.35 volts to the bridge circuit.

A.c. voltages are not applied directly to the divider network, but instead are rectified, peak-to-peak, by means of the twin diode section of a 6BN8, a three-section tube containing two diodes and a triode. The triode section of this tube is used to amplify low-level a.c. voltages before they are rectified. A special circuit is incorporated to balance out the contact potential which normally develops in vacuum tube diodes.

Resistance measurements are made by applying the voltage of a D cell (nominally 1.5 volts) across the unknown resistor and one or more of the voltage-divider resistors. The voltage applied to the bridge circuit then will be a function of the resistance ratio between the internal resistors and the unknown resistor.

The power supply consists of a power transformer which supplies a half-wave selenium rectifier with RC filtering plus a neon lamp for regulation. A separate winding on the transformer supplies heater voltage for the 12AU7 and the triode section of the 6BN8.

Construction

The KT-174 goes together very easily and in less than ten hours if our experience can be used as a guide. The most difficult part of the assembly procedure is in wiring the range switch. The remainder of the circuit is contained on a printed-circuit board which is rather simple to assemble. The manual is clear and so are the illustrations. We were especially pleased by the large pictorials on separate 17 × 22 sheets; they certainly help to locate components, and we find it more convenient to read an illustration hanging in front of us than one lying on a table with the rest of the manual.

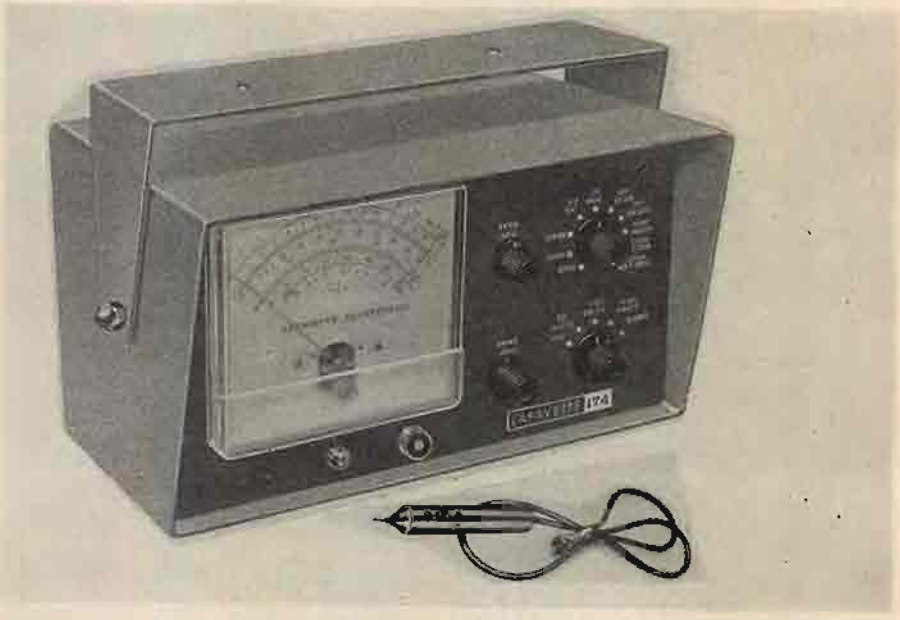

Fig. 5. Lafayette VTVM, Model KT-174.

Performance

The Lafayette KT-174 is not intended to be a laboratory instrument but rather a general purpose meter which can be used for alignment and checking assignments. We mention this because the ±5 per cent accuracy for the a.c. scales clearly place it in the general purpose category. On the other hand accuracy of this order is quite acceptable for the serviceman or the audiofan who likes to build kits or service his own equipment. In fact the low a.c. ranges and the zero-center indication make it especially valuable for the audiofan. Another valuable asset is the low price tag. **M-22**

SOUNDTALK

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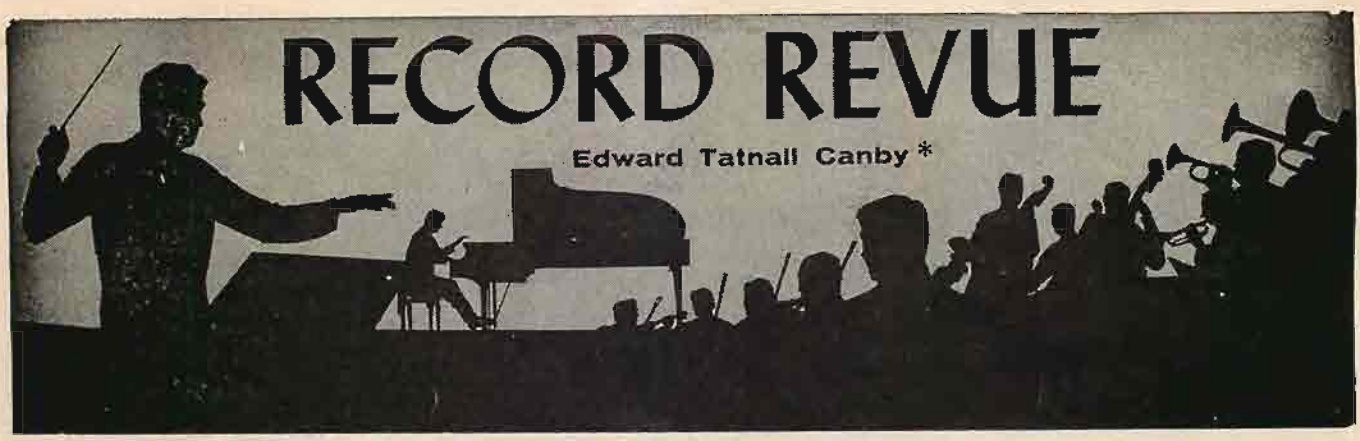

RECORD REVUE

Edward Tatnall Canby *

Note: A note from Vox says that Vox Boxes 27, 28 and 29, the complete organ music of Buxtehude (reviewed last month on P. 70), are not reissues and will shortly be released in stereo. They sent us the mono, released first. All Vox reissues, the company says, are clearly stated so in the lower lefthand corner of the album notes. The reissue idea remains a good one, given worthwhile musical material. Reissues are almost always dramatically improved over the (more expensive) originals.
E.T.C.

Philharmonic Hall!
Brahms: Symphony No. 2. New York Philharmonic, Bernstein.
Columbia MS 6374 stereo

Philharmonic Hall! Who hasn't followed the excitement, sociable and acoustical, attendant on the completion of this ultra-modern concert auditorium. The acoustical arguments still wage hotly and they will not cease—for, you see, Philharmonic Hall is adjustable. Wiggle the floating islands, bring up hidden reflecting panels behind the stage "grille," juggle this, adjust that. This recording was made 'way back in Tuning Week, last spring, and much has happened since. Columbia, for instance, crows about the superb bass response. Reviewers almost unanimously mentioned lack of good bass at the Opening Nights. Nevertheless, the record proves a lot—though very little about the hall's "live" virtues. What it indicates is that the Philharmonic may have found just what it needs—for recording.

The sound here is immediately effective, and to my way of thinking, very good of its type. Dry, clear, close, warm, the entire orchestra picked up with chamber music clarity yet orchestral expansiveness.

Moreover, the acoustical impact is the greater for the musical excitement clearly evident in the playing. The boys were trying out their new permanent home for the first time and they worked with enthusiasm.

Don't expect this to sound like Carnegie Hall, nor like the local armory or American Legion homes used so often to get big liveness into our symphony music. Nor like the great older halls of Europe. This is the new style—both in the hall and in the stereo recording itself. Like it or no, it is probably with us to stay. And you won't find a better example of rapport between the miking and the hall itself anywhere I know of.

AUDITIES

You're Stepping On My Shadow. Nine Sound-Stories with Tony Schwartz.
Folkways FD 5582 mono

Tony Schwartz is New York's genius of the candid tape recorder—and the nation's host in many an ingenious commercial advertisement on radio and TV, made out of his own sound recordings. Every week Tony puts on a short sound-story at our municipal station, WNYC (I'm on the same station myself). Here are nine of them, one of which, an interview with a highly imaginative little girl—unrehearsed, of course—gives the title to the disc.

They aren't all of equal interest, though none of us, I hope, will agree as to which is best, or worst. But all show Tony's own quick imagination and his ability—Heaven knows how—to get ordinary people to do and say things for his mike without a trace of self-consciousness. (In this respect he is truly candid, whereas the "candid" camera people are often much less than that.) We have here a history of a voice—a little girl, first aged a few hours and then periodically until age nine—quite fascinating. There's a wonderful "Portrait of Lincoln," assorted comment by the passersby on the great man, including the earnest misinformation that he was born in 1949! There's a fire in the house—real and gripping. There are people making amusing comments about the million-dollar picture of Aristotle Contemplating the Bust of Homer—a few feet from the picture itself in the Metropolitan Museum. Priceless. Aren't people wonderful! That's what you'll always say after a Tony Schwartz recording.

The Heifetz-Piatigorsky Concerts. (Quintets, Sextet, Octet). With Primrose, Pennario and Guests.
RCA VICTOR LDS 6159 (3) stereo

The above is approximately the title on the album, except that RCA spells it "Quintettes" . . . Here we have The Mozart G Minor Viola Quintet, the Schubert C Major, with second cello, the Franck F Minor Piano Quintet, the Brahms G Major String Sextet and the Mendelssohn Octet for strings and winds. Quite a parcel. It's a Soria job, which means fancy album and a big book, black-and-white and buff, full of snapshots of the artists, the recording sessions, the concerts. More important are brief sections on each composer with excellent contemporary illustrations.

RCA Victor's theory is, as always, that it's bound to be good chamber music weather when big-name solo artists get together. They say so here as they did years back with the "million dollar trio," sporting some of the present personnel, and many a buyer will go along with them. A few of us, however, have mild reservations in principle.

Yes, these are dynamic, exciting, masterful performances. That can be expected with the leadership of those highly gifted old pros, Heifetz, Piatigorsky and Primrose. (Of the three, only Primrose and his viola are frequently heard in chamber music performance.) The "guests," including oddly enough Capitol's Leonard Pennario where we would ordinarily expect RCA's Artur Rubinstein, go merrily along with this dynamic leadership.

Nevertheless, this isn't really chamber music. There is no hiding the sound of an ensemble of mostly habitual soloists. There are rough edges, along with authority. There is a lack of that supreme sacrifice, the perfect ensemble blend, that is the biggest attraction of top-quality chamber music playing. And one feels, strongly, that this group has merely rehearsed long and faithfully; whereas a true chamber music group, or at least the basic nucleus of it, lives together in music, fusing its musical identity as closely as any family group, over months, years, decades.

With all this in mind, you'll still enjoy the album's broad coverage and, its outstanding musical impact. But there are more perfect performances of each work elsewhere, I think.

Tennyson/Strauss: Enoch Arden. Claude Rains; Glenn Gould, piano.
Columbia MS 6341 stereo

In 1890, Richard Strauss composed piano accompanying music to Tennyson's enormously successful—and now highly dated—"Idyll" of 1864, "Enoch Arden." A strange combination, but it seems that this sort of thing was marketable in 1890 for stage presentation, though our present concept of background music was far in the future. The Strauss piano score is liquidly sentimental and very Wagnerian in its *leitmotiv* construction, a theme for everybody, invariably played at the slightest mention of each character, the themes intertwined and developed along with the people in the story.

Actually, in recorded form the combination isn't so far-fetched today and the Strauss music is gratifying Straussian, for any ear that knows the composer. The story was once a realistic tragedy; it still can evoke some of that feeling in spite of its Victorian framework. Rains is a capable reader and Gould has an easy affinity, always, for late-Romantic music.

The main trouble here is all Columbia's fault: the piano, it seems to me, is far too subordinate. Not only too faint, but off in the background. As in a solo-and-piano sonata, this work should have its piano and voice on a tonal equality. It doesn't here.

MODERATELY MODERN

Prokofieff: Romeo and Juliet; highlights. Prokofieff: Cinderella; highlights. L'Orch. de la Suisse Romande, Ansermet.
London CS 6240, CS 6242 stereo

Here are instrumental highlights—at length and considerably more than the usual idea of "highlights"—from two of Prokofieff's late ballet scores.

Russian ballets are customarily evening-long and the music, by itself, gets to be pretty longwinded; it is often padded out, of necessity. This is no less true of Tchaikowsky than of Prokofieff many years later. Concert-size suites have been made again and again, to adapt parts of the huge scores for straight listening—"Romeo" provided two concert suites and some extra piano pieces. But where the full scores are too long for listening at a sitting, the suites are generally too short by themselves. Hence these excelent LP "highlights," much more thorough than the suites heard in concert but with the repetitive padding boiled out, for straight listening. Short of the actual ballets on stage, these give us the truest picture of the musical worth of the scores.

The earlier work, "Romeo and Juliet" dates from 1935, "Peter and the Wolf" time, when the composer was fresh back in the home land and trying out his new soft-and-Romantic style, still sassed up a bit with the Nineteen Twenties. Prokofieff at his best. "Cinderella,"

composed during the early war years, shows a sadder, wiser man, already beginning to show a certain decline of forcefulness that continued, rather poignantly, in his postwar music. It is no longer fresh and snappy, this music, and it is rather too full of cliches, out of the Soviet school. (You can hear "Gayne" and assorted Shostakovitch if you want to.) But it also is more serious, more appealing, and just as expertly constructed, as "Romeo."

Not a trace, of course, of present-day modernity, which simply did not reach into Prokofieff's life. Tragic that he did not live until the times of the recent cultural rapprochement that has brought a very considerable interchange of ideas, cold war or no, between Soviet and Western art. Prokofieff would have benefited enormously. Will any current Russian composer? They are lesser folk.

Prokofieff: Love for Three Oranges. Chopin: Les Sylphides. Boston Pops, Fiedler.

RCA VICTOR LSC 2621 stereo

I'd rather hear the Boston orchestra under Fiedler any day than under its former conductor, just retired, Charles Munch. (Reservations on the new man, Leinsdorf.) Fiedler is hardly profound but his conducting always brings out a sprightliness that engages the musical ear pleasantly.

"Three Oranges" is an early Prokofieff work, the young radical at his most snazzy, first produced in 1921 in, of all places, Chicago. It didn't do very well in Samuel Insull's heavy-handed era, or so I'm told. It thumbs its nose in all directions, as you'll quickly hear. You'll immediately recognize the famous and zany March, the only piece that managed to stay alive continuously over the years; the rest is in the same spirit. Very lively.

I didn't play "Les Sylphides" but you can count on a lively playing of that Chopin-based ballet suite, in the usual Pops manner.

Copland: Appalachian Spring; Billy the Kid. London Symphony, Dorati.

Mercury SR 90246 stereo

Following hard on last month's Bernstein-N. Y. Philharmonic version of these works, (as I played them, that is), this British recording with the ex-Minneapolis conductor was an interesting experience.

"Appalachian Spring" I found unusually moving, with that peculiarly calm purity, at its beginning and end, most beautifully projected. It seemed to me, somehow, that here the English orchestra was "eating up" a style wholly American and wholly dignified, which may have struck them as extraordinarily interesting to play. Copland in a way writes simple music; but his instrumentation—the part that hits the players directly—is highly sophisticated.

On the other hand, for reasons inexplicable, the much snazzier, more violent, Western-style "Billy The Kid" is played like a lump of lead. Well, maybe a lump of soft iron, then. Here—using my same imagination—I sensed that the tension of the music, both in its lively moments and its gunfire, was somehow alien to the British players. The shooting-down of Billy, via drums and rattling machine gun sounds, is unutterably soggy. The dissonances sound like mistakes. They aren't.

A Festival of French Organ Music (Widor, Saint-Saëns, Franck, Gigout, Vierne, Alain, Dupré). E. Power Biggs, organ of St. George's, New York.

Columbia MS 6307 stereo

E. Power Biggs hasn't entirely deserted his usual field here, "authentic" Baroque-style organ playing. This is music from the far reaches of the late French Romantic school, to be sure, and very much removed from Bach & Co. But the organ is a big new one (1958) designed by Ernest White. Though it is technically a "Romantic" instrument—probably with classic-style stops as well—it is clearly influenced by the Biggs-favored revival of the old organs. Colors are brighter, more varied, spatial placement is dramatic, with three divisions, right, left and ahead, and in particular, the organ is voiced to fit the church's acoustics with unusual success; every note is clearly audible in the long-period reverberation, as with the famous old organs in Europe.

The Biggs program isn't all heavy; several items are nicely humorous and colorful. Stereo is in its element here, too. The three spaced banks of organ pipes, widely separated, are ever so clearly reproduced—not ping-pong-style, ABC, but always within the large space. Finally, Mr. Biggs playing, though perhaps not to the taste of most church organists, tends to stress sharp colors and separations, playing down the ubiquitous swell box effects that are usual in this sort of music. Mr. Biggs doesn't like swell boxes and neither do I. (Their effect is exactly similar to the old-time use of console doors as volume controls for the acoustic and orthophonic phonographs!) The swell box seemed a fine idea, a century ago; somehow we today prefer to hear our volume differences naturally produced, by actual changes in registration, changes in the combinations of pipes. That's a Biggs specialty, even here.

MODERATELY OLD

Schubert Songs. Gérard Souzay; Dalton Baldwin, piano.

Philips PHS 900-007 stereo

It was a pleasure to welcome Philips to our shores under its own label. And odd to find in its catalogue the familiar names we've known for so long on the Epic label, which used to be the Philips outlet. These new discs are like Fords with Chevy motors! Mercury is now the purveying company, instead of Columbia. (Mercury is now a Philips acquisition, as Capitol is for EMI.)

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STEREO—AFSD 5981/MONO—AFLP 1981

LEVEE LOUNGERS at the Golden Garter —Hey-Lylee and other rousers including: Daisy, Cotton & Corn, Five Foot Two, Railroad. AFLP 1977/ AFSD 5977

MOVIE THEME HITS, Jo Basile & Accordion —Tonight, Ai Di La, Moon River, Never On Sunday, Pepe, Maria, others. AFLP 1979/ AFSD 5979

EL DEBKE, Naif Aghy & Orch. —Music of the Middle East, Ya Samra, Melie Ya Helwee, Kabber-Kabber, Raksat Wadad, others. AFLP 1980/ AFSD 5980

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At first thought, Schubert-lovers may quail at the idea of a French-type baritone singing Schubert. Not to mention an English-type pianist. It is true that Schubert songs in particular and above all can suffer when misunderstood by a non-Germanic artist. Never fear. This is a superb set of performances, even though the Souzay voice is not the traditional sort usually heard out of Germany or Austria. The man is a fine musician, obviously of wide musical understanding and culture. That's all we need. I have seldom been so moved as I was by some of these performances.

Note that the voice is not only controlled to a frequent pianissimo, but Phillips has placed the singer on a real equality with the piano—sometimes almost covered by the piano sound. Precisely right. It's high time we recorded more of our great voices in a natural perspective and at natural volume. The day of the close-mike soloist is over—or should be.

Bach: Sonatas and Partitas for Solo Violin. Arthur Grumiaux.
Philips PH 2-900 (2) stereo.

Terrific. Arthur Grumiaux, long known for his splendidly musical recordings on the Epic label, here reaches to the heights in one of the traditionally most difficult violin assignments in all the literature. And what a recording!

Not only difficult technically—for the incredible double-stops and multiple voice parts in these works demand fantastic technique—but even more difficult musically. Some of the biggest violinists make hash of the music simply because they do not hear its implied harmonies and the implied complex of musical strands or lines of melody. Or if they do, their playing mannerisms may not get the sense over to the listener, especially in terms of rhythm.

Grumiaux has a faultless ear, a perfect and easy knowledge of the implied harmonic sequences and an excellent grasp of the juggling that keeps up to four musical "melodies" going at once in the music. He knows, unlike some fiddlers, that Bach would have expected an older type of bow, arched, and undoubtedly capable of more relaxed three-string and four-string chords; like all present-day players, Grumiaux has to sweat to get out the Bach chords; but he makes it show less than most. And in addition, he benefits from the newer and more rigidly mathematical playing style in vogue today among younger artists of all types. Many an old violin maestro played these pieces with so much "rubber" in the timing, so much rubato, such extra-fancy phrasing, that few listeners could make head or tail of the rhythms. Grumiaux ploughs resolutely ahead without frills, but musically. You can follow the beat and the rhythms with exceptional ease.

Finally, Philips has given us an ideal big stereo recording, in a resonant space. Fine stereo room-sound. More important, a big fiddle tone and a blending that helps immensely to fuse the sound into the intended harmonies. For these are big pieces, "orchestral" in scope, sketched out in a sort of shorthand on the solo violin. A good reverberation makes chords out of arpeggios that *are* chords, implied. In sum, we never had it so easy. Almost anyone who likes a bit of Bach will enjoy these discs.

Bach: The Complete Brandenburg Concerti. Philharmonia Orch., Klemperer.
Angel 3627 B (2) stereo

A "definitive" recording of the six Bach Brandenburgs, with their marvelous variety of instrumental color, their catchy themes and rhythms, seems to be hailed every year or so. My last, if I remember, was also from England, with Yehudi Menuhin.

This one is terrific—if you enjoy stunning close-up recording, "authentic" small-group instrumentation and a slightly old-fashioned conductorial approach, taking each movement at an optimum pace for leisurely exploration. No frantic rush here, and it's a good thing. The fad for high-speed tempi is getting tiresome; so much is obscured, so much is sloppy and unmusical in exchange for what seems most to be desired—tension, brilliance, nuclear propulsion. Not here.

Each of these is a gem of interest in the

broad, widened, spread-apart recording; every instrument is present and directional—you can almost reach out and touch each. Yet the space is mellow, live, imaginatively real. Particularly in the music of the two string concerti, the Third and Sixth, this accurate separation of the multiple strands is precisely what the music needs.

Handel: Messiah. Ritchie, Shacklock, Herbert, Standen; London Philharmonic Choir, London Symphony, Scherchen. **Vanguard BG 631/3 (3) mono.**

Well whadd'ya know! A new cover, new pressing, new label, but this is none other than the old Westminster "Messiah," WAL 306, the *first* Westminster "Messiah," which I acquired early in 1954. (Five years later, Westminster re-did it in stereo with Scherchen in a Viennese performance, but issued the new job in the same white album as the old one. Used the same annotations, too—by yours truly.) Vanguard has stuck a label on this new release, tactfully marked "label removable," which says YOUR PRICE $9.96. I tried to remove it but it wouldn't come off. That's a commentary on pricing for you!

I got out the old recording—which cost a lot more—and am glad to report that the new version is technically much improved, as could be expected, in particular via noiseless surfaces, where the old one had the noisy pops still common in 1954, and in a re-equalization to RIAA, where the old Westminster used the then Columbia curve. (RIAA became effective a year or so later.)

The Scherchen "Messiah," regularly plugged as the original "Dublin version" (the first performance was in Dublin) is hardly that, nor is it "authentic" in the current sense, beyond a moderate degree. Small group, harpsichord, some restored instrumental solos and general scaling-down—yes. But Scherchen's "re-studied" tempi, claimed to be chosen in the light of 18th century practice, strike me as more often illuminated by Scherchen's eccentricity. Some are very fast, some dismally slow, upsetting the stolid old traditions right and left; many are exciting and will be hailed as improvements and a welcome release from out-of-date custom. But others many of us will find just arbitrary and often unmusical, doing violence to words and notes alike. Still—a simulating performance and never dull for a moment, with much fine British singing and playing, superior to that in the later Westminster stereo version out of Vienna. Fine sound, too.

The Virtuoso Recorder. Frans Brüggen; Janny van Wering, harpsichord. **Decca DL 10049 mono.**

This young Hollander, 28, is a breathtaking virtuoso on that once-amateurish revived instrument, the recorder. But the music he plays with such incredible fleetness and such excellent pitch and phrasing was composed, centuries back, for other virtuosi who clearly must have played just as well. One of the fascinating aspects of our modern interest in old music is the complete revival of such advanced playing techniques, virtually lost for centuries. The harpsichord came first, with Landowska. The recorder has been waxing more and more professional for a good many years. There is the "Bach trumpet," virtually unplayable only a quarter century back (Toscanini still substituted a shrill clarinet for it) and now widely and skillfully blown. There are the lutes, the viols, and now, such strange noisemakers as the krummhorn, serpent, zink, all coming back to professional performance standards.

Alas, only the "old voice"—the voice as it sounded in olden days—remains absent. Our present voices are largely neo-Caruso. . . .

Anyhow, Brüggen plays Telemann, Loeillet, De Fesch and Veracini, out of the 18th century heyday of recorder virtuosity, and the recorded sound is fantastically good as well as the playing. Congrats to the engineer—be he Dutch or American—who did this job.

There's even a duet, both recorders played by Brüggen via rerecording. The typically buzzing interference tones of a pair of recorders are heard, just as though the two were playing together "live"! That's synthetic authenticity for you. AE

NEW LITERATURE

• **Loudspeaker Catalog.** Jensen Catalog 165-H has just been released. The 2-color catalog covers all technical and styling details of Jensen's entire line of high fidelity loudspeaker and headphone equipment. An introduction by Ralph P. Glover, Executive Vice President, discusses the arguments for "slim" speakers as opposed to the normal bookshelf size. Mr. Glover comments also on stereo headphone listening and the exclusive Jensen CC-1 Space-Perspective system incorporating circuitry developed by CBS Laboratories. In addition to suggestions on building a new stereo system and an explanation of loudspeaker principles, the new catalog presents Jensen's 3-P speaker line and their shelf group which includes the compact X-20 and X-10 models. There is a section on Jensen's new headphone accessory prodproducts, with a discussion on the remote control of private listening. Outdoor speakers, component speakers, accessories and kits are also detailed in the new catalog. Jensen Mfg. Co., 6601 S. Laramie Ave., Chicago 38, Illinois. **M-1**

• **Lever-Switch Catalog.** The 6-page 2-color Switchcraft Catalog S-302 contains engineering drawings, specifications, and operating features of their line of lever-type switches. Detail specifications are given on the new "Lever-Lock" communications lever switch. This switch permanently locks in each switching position. A choice of contacts, circuits in 2- and 3-position types—locking and non-locking—is shown. Telever and Lev-R Switches are also described. A full page is given to illustrate and explain various product applications using varying lever-switch designs. Switchcraft, Inc., 5555 N. Elston Avenue, Chicago 30, Illinois. **M-2**

• **Transistor Book.** "Understanding Transistors—And How To Use Them" is a 96-page handbook of transistor fundamentals published by Allied Radio Corp., Chicago. The manual was prepared as an introduction to the subject of semiconductors for hobbyists and experimenters, and as a guide for home study and classroom use. Eleven chapter headings range from the history and development of the transistor to its performance characteristics and its use in various types of circuits. NPN, PNP, alloy-junction, drift, tetrode, surface barrier, power types, and other subjects are covered. Other sections describe transistor circuitry in such devices as a one-transistor radio, audio amplifier, capacity-operated relay and a photoelectric controller. A special section details construction and experimental projects. "Understanding Transistors" (Cat. No. 37 K 602) is available at 50 cents per copy, postpaid, from Allied Radio Corp., 100 N. Western Ave., Chicago 80, Illinois.

• **Record and Tape Review Book.** Argyle Publishing Corp. announces the publication November 13 of "The LP/Stereo Record Guide and Tape Review" by Warren DeMotte, with a foreward by Leopold Stokowski. Priced at 95 cents, this 320-page paperback book contains comparative reviews of thousands of stereo and mono pronograph records and stereo tapes. Among the interesting statistical features in the Guide are considerations of 33 renditions of "Scheherazade," 11 versions of Bach's "St. Matthew Passion," 38 of Schubert's "Unfinished Symphony," 28 of Vivaldi's "The Four Seasons," 11 albums of "La Boheme," and 29 renditions of Beethoven's "Appassionata Sonata." Warren DeMotte is the Record Editor of *Electronics Illustrated* Magazine and a former Associate Editor of *HiFi/Stereo Review* Magazine, for which he still regularly writes. Argyle Publishing Corp., 298 Fifth Ave., N. Y. C. 1, N. Y.

JAZZ and all that

CHARLES A. ROBERTSON

STEREO

Benny Goodman: Benny Goodman In Moscow **RCA Victor Stereo LS06008**

From the day of the Soviet Union's choice of Benny Goodman as the first jazz personality to go on an official tour of Moscow and five other cities, the project was the subject of a lot of conflicting opinion, originating both in this country and in press reports sent back from abroad. Now that the Cuban crisis has caused all the furor to be forgotten, the music in this two-record set can be enjoyed on its merits, without interference from the dissenting voices of political or musical bias. In fact, there should be something among the twenty-one selections to mollify just about every partisan of big-band jazz. All were recorded at concerts during a return visit to Moscow in the final week of the tour, at a time when the group was thoroughly seasoned and playing at top form. Whatever difficulties were encountered at rehearsals had been ironed out, and audience cheers and applause buried any uncertainty about the Russian reaction. Not only does the album live up to an historic occasion, but the band itself deserves a place beside the great Goodman outfits of the swing era.

Despite claims that Goodman gave short shrift to new material, there are a good half-dozen new numbers from the pens of Bob Prince, John Bunch, Tommy Newsom and Tadd Dameron. Particularly masterful is the performance of Dameron's *Fountainebleau*, an impressionistic sketch in three sections describing the famous gardens of the French palace. Whether the good work is due to the leader's discipline or resentment at his alleged indifference to contemporary writing, the results are gratifying enough to recommend his presence at similar dates in the future. Quite a few recent albums devoted to modern compositions or band innovations would be that much better for Goodman's guidance, either as leader or in the control room in a supervisory capacity. If any complaints are registered, they will probably come from faithful fans of twenty-five years ago, as some of the old arrangements show signs of refurbishing. There is a zesty sparkle to *Mission To Moscow*, and a fresh polish to *Stealin' Apples*.

The leader's clarinet sounds better than ever, but signs of mellowing might be detected in the generous amounts of solo space allotted to the likes of Joe Wilder, Phil Woods, Willie Dennis, Zoot Sims and John Bunch. A quintet medley brings Teddy Wilson's piano to the fore once again, and Vic Feldman, vibes, and trumpeter Joe Newman are featured on an attractive septet version of *Bei Mir Bist Du Schoen*. The stereo sound benefits from the auditorium's spacious acoustics, and the main engineering difficulty seems to have been a blown fuse. George Avakian's notes are about the first reports on the trip to be authoritative and not merely sensational or opinionated. With Goodman's successful tour on record, hopes are high that an invitation will go to Duke Ellington, Louis Armstrong or Count Basie. But whether Dizzy Gillespie will ever be allowed to unfurl a rhythmic Afro-Cuban specialty in Moscow is a question only time will decide.

Sit-In Songs: Songs Of The Freedom Riders **Dauntless Stereo DS4601**

When newspaper reporters and magazine writers first journey to a Southern town and cover a new round in the freedom fight, one of the things that impresses them most is the courageous singing of the demonstrators. Marchers are apt to burst into song at the slightest provocation, while sit-inners usually wait until being carted off to jail. Rarely does an article at some point fail to mention the great impact of the songs and massed voices. The New York Times sent Robert Shelton to Albany, Georgia, just to write about this single aspect of the story, and his investigations included a talk with Chief of Police Laurie Pritchett, who frankly admitted that the whole police force enjoyed the freedom songs and often sang or hummed along with the prisoners. A short time later, the Congress of Racial Equality loaded veterans of the Albany struggle into a freedom bus, turned it around, and headed back for a fund-raising drive in the North. This recording session was arranged during a stopover in Manhattan, and CORE will share in the royalties.

A freedom song consists of topical lyrics set to a familiar melody, and the words can be altered at will to fit a specific situation. Tempos and phrasing are also subject to change according to the fortunes of the moment, and the same song may swing along to a jaunty gospel beat or be used as a dirgeless lament. When not thinking up new verses, the singers while away the time by trying out imaginative vocal interpolations, until the whole song gradually becomes something different. All of which, if the folk authorities are to be believed, is the substance and method for creating folk music.

The youthful group of mixed voices from Albany can hardly be called a trained chorus, but every member knows spirituals and gospel songs inside out. They begin where Ray Charles left off on *Get Your Rights, Jack*, one of the few recruits drafted from the pop field, and the amount of humor expressed may cause some amazement among listeners in the North, particularly those who are accustomed to unsmiling jazz figures. Another adaptation derives from *St. James Infirmary*, which soloist William Bradford transforms into a moving *We Went Down To Mississippi*. Hank Thomas steps into the role of old-fashioned preacher to deliver a timely message on *Do You Want Your Freedom?* A pianist and an organist, on opposite sides of the stereo stage, help to keep the marchers from straying out of line. The full text of these dozen songs, along with several others, may be obtained by sending a quarter to CORE, at 38 Park Row, New York 38, N. Y.

Once known as Dauntless International, the new label is a subsidiary of Audio Fidelity and will handle other special projects of an unusual nature. It will also be used to develop artists not on the parent company's current list. A lower price tag in no way means a lessening in the quality of pressings, and the same high engineering standards are maintained. The only evidence of economy is the absence of a four-color cover, a thoroughly expendable item. This introductory release was one of the first assignments for Tom Wilson, new artists and repertoire director for both labels. A seasoned jazz buff, Wilson started in Boston with Transition, then moved on to United Artists before taking the present post. Foremost among his plans are several ambitious and novel jazz albums.

The Arthur Logan Singers: Roots **Pinnacle Stereo PLP1065**

Every young jazz player talks about roots these days, but too many look in the wrong places and never get back to the basic truths of this recording. Their experience with Negro church music may be limited to a few contemporary gospel groups, and what they know of its influence on jazz often starts with Milt Jackson and ends with Les McCann. The older ways of singing spirituals and jubilees are thought of as being too prosaic for this age of rockets and space capsules. The average college glee club appears to be supplied with trickier arrangements than those the Fisk Jubilee Singers first took along to astound audiences in Europe. To meet competition from this and other quarters, directors of church choirs must keep up to date and be alert to changing trends. Arthur Logan, who has directed the Goodwill Choir of Chicago for the past nineteen years, demonstrates how the historical process works in a dozen examples taken from two concerts held at McCormick Place. To illustrate the traditional New Orleans funeral parade, Franz Jackson and the Original Jass All-Stars join the fourteen-voice choir on *Just A Closer Walk With Thee*.

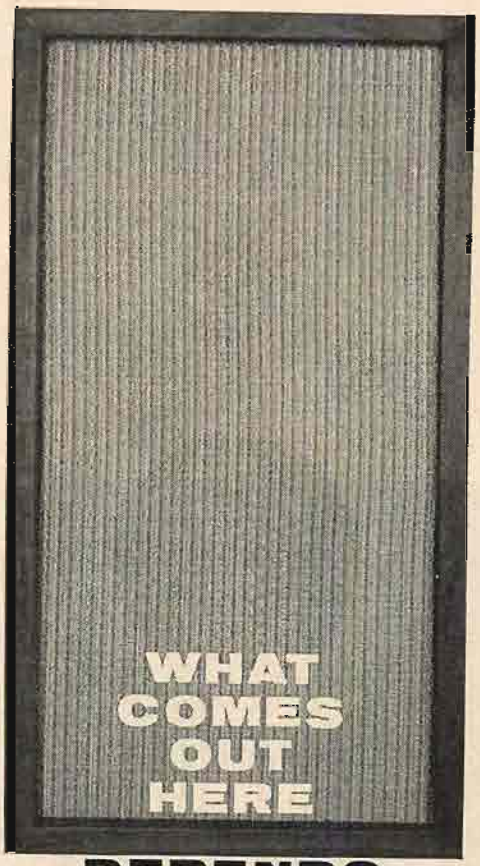
By incorporating as many as three different styles in a single song, Logan places the new and the old together in an order convenient for close comparisons. Besides presenting an enlightening review of progress to date, the program points up such rhythmic relationships as that existing between jubilees of nearly a century ago and the latest gospel beat. While the director's spoken introductions indicate disapproval of the extremes to which gospel music is being carried, especially by pop singers, no sign of a restraining hand hampers Doris Grimes' spirited piano or such lively pieces as *Elijah Rock, Rockin' Jerusalem*, and *Climbin' Up The Mountain*. The ensemble work is always polished, with excellent solo passages by Maggie Bracey, Treopia Williams and Alvin Naylor. The All-Stars unite with the choir in a stirring finale, and a sequel bringing them together again for an entire album would be a welcome event. Jackson produced the date for release on his own label, and Ray Blaa's engineering of the stereo version should encourage any gospel group to take its trade to the same place.

Ella Fitzgerald: Sings The George and Ira Gershwin Song Book, Vol. 2 **Verve VSTP277 (4-track UST tape)**

In this instance, Twin-Pak means gift pack, as this four-track stereo tape adds up to two and one-half albums and sells at a bargain price to Christmas shoppers, due to a special rebate slip enclosed in the wrapping. The original set was released as five albums, and tape combines the last two and part of the third for a total playing time of eighty-seven minutes and thirty seconds. That should be enough to break in a new tape recorder, with some left over to decorate the tree. Actually, both Ella Fitzgerald and arranger-conductor Nelson Riddle gave considerable thought to the pacing of this marathon session, and quite a few ordinary vocal albums prove tiring in much less time. Tape and stereo also contrive to give more body and dimension to the orchestral accompaniments. And no Gershwin fan ever complains of lack of variety, even while listening one after another to twenty-six selections. Some complaints may arise because one number, *Strike Up The Band*, disappears between the list on the container and the label on the tape spool. But then, anyone too disconsolate can always return to Ethel Merman for that rousing salute.

Joao Gilberto: Brazil's Brilliant Joao Gilberto **Capitol Stereo ST10280**
Laurindo Almeida & Bud Shank: Brazilliance/ Vol. Two **World-Pacific Stereo WP1419**

Whether the bossa nova craze lasts much longer or not, these albums will continue to be status symbols for collectors who like to prove they are ahead of the crowd. Neither cover carries the name of the new Brazilian dance rhythm, as both were released before it had gained much currency in this country. Joao Gilberto is described as a singer of pops



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in Portuguese, despite his thoroughly devastating attack on *I'm Looking Over A Four Leaf Clover*. Accompanied by Antonio Carlos Jobim's orchestra and his own persuasive guitar playing, he introduces works by native composers that are now being featured in jazz versions by just about every North American leader. Gilberto, who sounds somewhat like a youthful Bing Crosby, has already arrived here to display his vocal charms in concert and more recordings are on the way, but nothing will quite replace this first venture. The stereo recording is very effective, and it should be purchased before a new cover replaces the original.

Guitarist Laurindo Almeida and Bud Shank, alto sax, take credit for first combining jazz and native Brazilian music on a 10-inch LP, now available with a few additions as "Brazilliance/Vol. One (WP-1412.)) The second volume to be reissued was reviewed in these columns three years ago under the title "Holiday In Brazil," and a few copies of the original may still be around in stores for avid collectors. It was the arrival of these albums in Brazil that is reputed to have started Gilberto, Jobim and their countrymen on the bossa nova trail. It was also one of the early stereo releases, and the realistic sound of Gary Peacock's bass and two Indian tabla drums played by Chuck Flores helped prove the new dimension's ultimate worth.

MONO

James P. Johnson: Yamekraw
Folkways FJ2842

James P. Johnson: Father Of The Stride Piano
Columbia CL1780

At a time when the founder of stride piano is remembered in the catalogue under his own name by only a brace of LPs, the arrival of an additional pair becomes doubly welcome, especially as they both contain material never released before. Setting the pace for other members of the Harlem school of piano ticklers was just one of the numerous accomplishments of James P. Johnson, who enjoyed nothing so much as a night spent with friends, jousting at the piano. His accompaniments to various early blues singers were models of perfection, and most shops can still supply examples of his fine playing behind Bessie Smith. But much of his energy during the '20s was expanded on writing popular songs and scores for musical revues. He toured Europe as musical director of "Plantation Days," and he was invited to Hollywood during the first days of sound on film. Whenever possible, an hour or so would be stolen to work on more ambitious projects in the concert field, as Johnson finish music's Third Stream long before the current crop of anglers came along.

Through the help of such good friends as William Grant Still, W. C. Handy, Willard Robinson, and the auspices of ASCAP, Johnson met with greater success in securing performances of serious works in the concert hall and broadcast live on radio than Third Stream composers are able to achieve today. Hard as the depression was on his earnings, it did provide extra leisure for the writing and promotion of new works. The really damaging effect was on his recorded output, as the industry stopped pressing older titles and set up a cry of poverty at the sight of fresh manuscript. So great is the demand for scores now that final touches are often inked in the studio, and this arena is where the Third Stream finds its best chance to be heard. Because a similar opportunity was denied Johnson, the present generation knows first hand of his influence from the piano styles of Duke Ellington and Count Basie. These two releases should go a long way toward showing how Johnson was puzzled by some of the same problems modernists face, as well as revealing the fact that his pioneering blazed a trail for such pianists as Thelonious Monk, Ray Bryant, Bobby Scott, Red Garland, Tommy Flannagan and the late Eddie Costa.

Until Moses Asch consented to unveil the composer's piano version of *Yamekraw*, the sole recording of the concert works still

around was reputed to be a symphonic reading on Japanese Polydor of this rhapsodic sketch about a Negro section on the outskirts of Savannah, Georgia. Like George Gershwin's piano roll of *Rhapsody in Blue*, reclaimed a year or so ago on RCA Victor, the piano score is much less dated than the orchestral arrangement. Although thoroughly acquainted with such fancy lures as atonalism and modern dissonance, Johnson endeavored to demonstrate how spirituals and earthy blues themes could enrich conventional frameworks. While keeping closer to true blues intonation and feeling than similar efforts by Dvorak, Stravinsky and Milhaud, the orchestrations were too bland for jazz enthusiasts and too unsophisticated for the concert audiences at which they were aimed. Nor did they reduce to the same common denominator that Gershwin's did, with the resulting huge attraction for the public at large. Because jazz tastes were relatively unformed and the subject itself not always clearly defined, Johnson can be excused for departing too far from the type of music he was best qualified to write. Now that the body of jazz listeners has grown in size and wisdom, Third Stream composers should not make the same mistake and let such a prize swim away. Both they and other modern arrangers can learn much from Johnson's career, and a good start would be to try writing vigorous, new treatments of some of his scores. They are certainly worthy of the attentions of Gary McFarland, Oliver Nelson or Bobby Scott.

Anyone looking for jazz roots will find they grow deep in *Yamekraw*, which draws on a wide variety of source material, including *Everytime I Feel The Spirit*, and *Sam Jones Don Snagged His Britches*. Perry Bradford, who published the score and also often collaborated with Johnson, supplies an example of the last title among four early recordings of syncopated novelty tunes added by way of documentation. Dating from 1921, and the days of Johnson's Harmony Seven, about the only distinguishing feature is the leader's piano.

The Columbia set also harks back to the period of acoustic recording, with such classic solos from the Okeh label as *Carolina Shout*, and *Snowy Morning Blues*. Ten of the sixteen performances were recorded in 1939 and never issued here, including five with a small band. The presence of Gene Sedric, along with Red Allen, J. C. Higginbotham and Sid Catlett, points up a comparison to one of Fats Waller's priceless band dates. Anna Robinson sings the Langston Hughes lyrics to *Hungry Blues*, and Duke Ellington reminisces on the linear about his old friend and mentor.

Ten Great Bands (Five Volume Set)
RCA Victor LPM6702

The bands of the swing era always played for dancers, and the listening audience could be grateful for any brilliant jazz solos. This five-disk gathering is pretty much proof of the pudding, as the ten great bands presented by producer Brad McCuen are largely involved in typical dance sets, with the choice jazz bits firmly imbedded in set arrangements. About the only exception is Lionel Hampton's small studio crew of sidemen borrowed from Duke Ellington and Benny Goodman. Each leader is alloted one side consisting of six selections, and the programs recall one of the many radio broadcasts from resort or hotel ballrooms. Every number is new to LP, and a few were never issued before, notably Tommy Dorsey playing a 12-inch 78 rpm version of *I'm Getting Sentimental Over You*, a second Goodman master of *Please Be Kind*, and Ivie Anderson vocalizing on Ellington's *Jump For Joy*. Parents with a sedate image still intact are advised to keep modern youth from laying hands on such nonsense songs as Hal Kemp's reading of *Three Little Fishes*, Larry Clinton's *Abba Dabba*, and Count Basie's *Open The Door, Richard!* Glenn Miller and Louis Armstrong are also head from, and Oran "Lips" Page joins Artie Shaw on *Take Off Your Shoes, Baby*. The collection, which carries a reduced price tag, seems to be pressed for utility from harder material than current stereo releases. AE

LEAKAGE INDUCTANCE

(*from page 30*)

any form of amplifier matching a dynamic speaker.

Now we add the impedance-changing feature made extremely simple by leakage inductance. At higher frequencies, the amplifier is matched by the 600-cps value of loudspeaker impedance. But at lower frequencies the same matching load for the amplifier is provided by an impedance several times as great, following the ideal impedance curve of (D). With an impedance following this curve the output tubes would 'see' a constant resistance. This immediately raises the natural power-available curve of (B) to that shown at (E), without any change in damping factor.

Note that now the amplifier comes close to correct match at frequencies not far above and below the resonant peak in impedance as well as at the minimum-impedance frequency from 600 to 1000 cps. The impression of increased available power can be tremendous, and distortion is maintained low, because the output tubes are matched more closely to their correct load impedance at all frequencies. It's like multiplying the available power of an amplifier by five times or more, and cutting its distortion at the same time. Who can object to that?

Figure 13 shows how it's done physically. At (A) is the circuit, while (B) shows the physical layout of the windings in the window space that will achieve it.

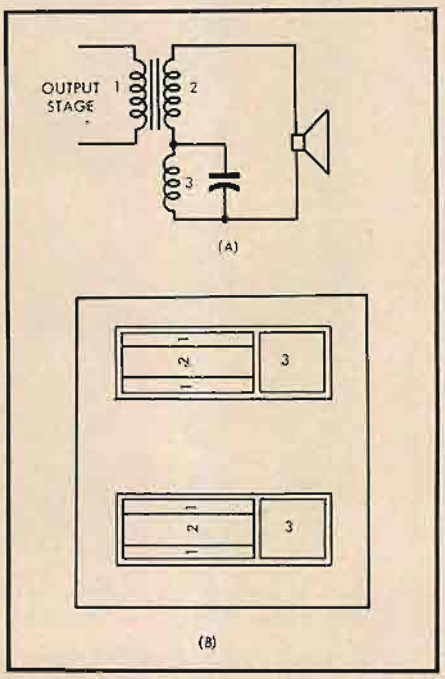

Fig. 13. Arrangement of special output transformer with impedance match of curve (D), Fig. 12.

In summary, these few examples show the versatility of leakage inductance when used as a circuit element. Because of power economy, in that last case, the output transformer, with its extra winding, can actually be smaller than in the prototype amplifier, while still delivering much more power to the loudspeaker. Proper use of leakage inductance in audio work comes the closest we have seen to enabling you to "eat your cake and still have it." Æ

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LIGHT LISTENING

(*from page 10*)

tion, in particular, recorded with the same closeup impact of the rest of the orchestra, is kept very busy. Certainly the man at the mixing board deserves a special word of commendation. The 35 MM technique really gets a chance to shine in this release as the Light organization subjects each passage to microscopic scrutiny. It's a scrutiny the same instruments would never get were you to listen to the same recording session from any seat in the house.

The Melachrino disc may seem tame should you happen to play it right after the Command opus. Considered on its own merits, it is easily the best sounding stereo disc we have to date by Melachrino's smooth-working outfit. Perspective is just as natural as the instrumental timbre; you see the orchestra instead of swimming about inside it. The response in the rhythm section would indicate that a different mike has been aimed at the bass fiddle. That stalwart of the rhythm area now emerges in a reproduced form that somehow manages to combine lushness with the good tight sound found only in the best of today's stereo discs. Melachrino's lineup of tunes includes several of the composer's items that are seldom performed these days: *Reaching for the Moon* from the 1930 Boardway show of the same name and *When I Lost You* written by Berlin in 1912 following the death of his first wife. Although far less sensational than the Command disc, this release will hold its appeal when the latest fads have died away.

Sergio Franchi: Romantic Italian Songs
RCA Victor LSC 2640

When one of the characters in Cole Porter's "Kiss Me Kate" remarks that there's lots of "quail" in Cremona, he is telling only part of the story. RCA's latest tenor discovery happens to be a native of that Italian city. If Sergio Franchi continues the pace he has set in his debut album, he is sure to do almost as much for Cremona as he will for the coffers of RCA. With the build and looks that Ezio Pinza had at the start of his career, Franchi is bound to prove strong box office in concert appearances. Whenever a promising tenor emerges from Italy these days, he is usually snapped up by the opera impresarios but RCA Victor seems to be grooming Franchi to occupy several niches in their artist roster. Since the death of Mario Lanza, Victor has been without the services of a tenor able to belt out the romantic Italian songs that always sell to the record buying public. Even when Lanza was around, he wasn't able to match all the talents of some of the tenors under contract at other labels. Such tenor stars as Giuseppe Di Stefano, Franco Corelli and Mario Del Monaco have done well with Neopolitan songs. RCA is now going after that market with a talent discovered in England by conductor Norman Luboff. Before the tenor came to Luboff's attention on the British television program "Sunday Night at the Palladium," he had gone through many of the preliminary stages for the career he now faces. When Franchi's family moved from Italy to South Africa in 1952, he studied voice while working as a part-time draftsman. Once his career got under way in operetta, he was soon signed for an operatic tour by South Africa's foremost impresario. Concert and television appearances in Switzerland, Germany, France and Holland preceded Franchi's encounter with Luboff in March 1962. The tenor was hired by RCA on the basis of two selections recorded in England and shipped here for audition. Perhaps an even more significant augury is the fact that Sol Hurok signed Franchi for an American concert tour sight unseen after listening to his recordings. In his debut album the tenor is assisted by a chorus and orchestra under the direction of Wally Stott. The program includes a cross section of Italian favorites (*Marechiare, O Sole Mio, Mattinata* and *Torna a Sorriento*) which Franchi delivers with the proper amount of quicksilver in the voice. All he needs now is the final layer of poise and polish that an American concert tour is sure to give him. AE

EDITOR'S REVIEW

(*from page 16*)

dium with quality programming. We are all aware of the fact that AM radio (except for a mere handful of stations), when confronted by the challenge of TV, took to the lowlands where quality programs were concerned—some people have been unkind enough to call AM radio "a giant jukebox." On the other hand, we are aware also that FM radio (except for the adjuncts to some large AM stations) generally has had a much higher quality of programming, as well as an inherently better sound quality. Unfortunately (or perhaps fortunately?), the higher cultural order of the FM programming has provoked little interest amongst the major advertizers. We will not speculate why. Now, however, with the advent of FM-stereo and the attendant original excitement, some major commercial interests have taken notice to the extent of actually plunking down money for a *network* FM program. Yes, network! A combination of 40 FM stations which are members of, or affiliated with, the QXR Network. To our way of thinking this is of potentially greater value for the audiofan than FM-stereo itself since with major budgets there undoubtedly will be a greater emphasis on live performances than heretofore, live performances by the great artists. Also there will be a much more active heralding of FM and its virtues. We may well experience a surge of excellent programs.

Transistors

For many years the transistor has tantalized the audio engineer because of certain technical properties: it is a low-impedance device with extremely fast recovery time. Of course we have all heard about those other virtues of low heat and small size *ad nauseum;* frankly, these virtues are significant only in military or mobile applications. To the audiofan, the only reason for countenancing a new device is that it will give him better performance. Thus we come back to the properties we mentioned at the outset which permit greater bandwidth with excellent transient response. Unfortunately in the past, engineers have been unable to take advantage of these devices because the good ones were just too costly—and *not* because the devices didn't exist. Now, several manufacturers have decided (or rather the engineers have convinced management) that the transistor provides such excellent performance that they should market equipment even though the transistor prices are still relatively high (lower than they were but still 10 to 20 times higher than tubes in power applications). Actually, this decision to go ahead will materially affect prices in future equipment as more transistors are used in audio applications. Thus we can see a trend in motion: this year there were very few types of transistor equipment available and those that did appear were relatively expensive; next year there will be much more equipment with some reduction in the price level—we would expect major entries this year; the year after next there will be some second generation equipment; and again many new entries. Altogether we would expect that transistor equipment will be as common as tube equipment two years from now (yes, we think that they will co-exist). We also expect "transistor fever" to become virulent during this period of time. If you are like us you can expect to get bitten by the bug (we are not able to resist a new device) therefore start saving those pennies now so that you don't have to raid your child's piggy bank—again. AE

ABOUT MUSIC

Harold Lawrence

A Tale of Two Halls

PHILHARMONIC HALL at Lincoln Center is settling down. The first week was hectic. There was opening night with the milling throngs, the ropes and barricades, 800 chauffeur-driven limousines, elegant ladies and their well-dressed escorts, police in tuxedos, klieg lights and television cameras. Inside the auditorium, Leonard Bernstein waited in the wings with a battery of over a hundred orchestral musicians, three choruses, and thirteen famous soloists. For social and cultural elite it was the biggest night in New York since the opening of the Museum of Modern Art.

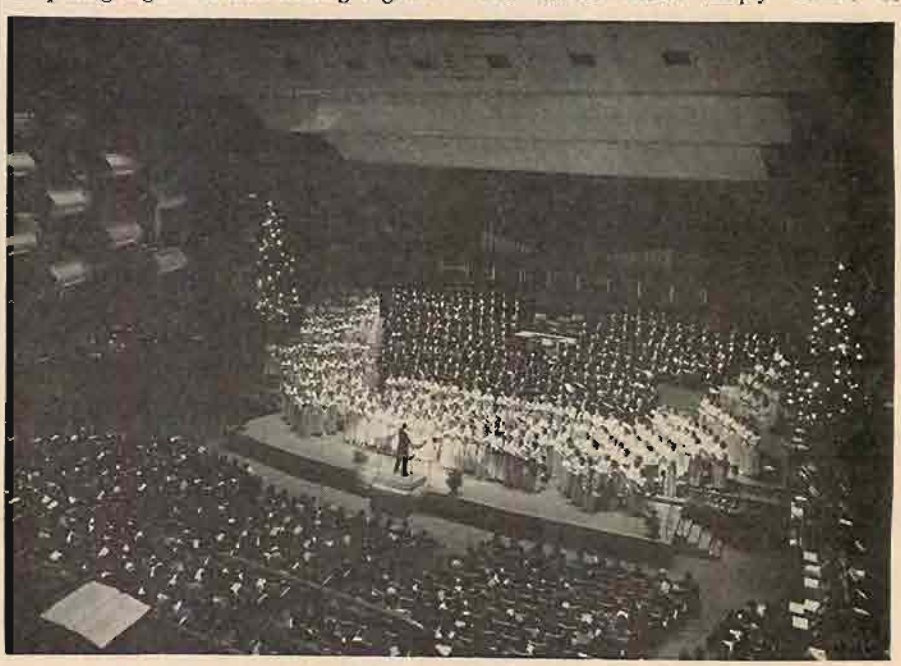
For Dr. Leo L. Beranek it was one of the biggest nights of his career. As president of Bolt, Beranek, and Newman, he had been entrusted with the acoustical design of the first public concert hall of orchestral size in New York since Carnegie Hall was built in 1890. Now the distinguished audience moving up the escalator toward the spanking new hall would, in less than two hours, size up the result of six years of planning, which included an intensive study of 54 concert and opera halls on four continents. What would they say?

"The first night was a near disaster, acoustically," reported Harold C. Schonberg, critic of *The New York Times*. "Listening to the music in Philharmonic Hall on opening night was like hearing a giant hi-fi set, with the characteristic shrill and hard high-frequencies so dear to hi-fi buffs," wrote Paul Henry Lang in *The New York Herald Tribune*.

What had gone wrong? Not a thing, said the acousticians, who had not made flat predictions that the hall would be trouble-free from the start. Provisions had been made for "tuning" adjustments, using canopies, baffles, risers, absorptive and reflective panels, and other devices. Dr. Beranek estimated that these refinements might keep the acoustical engineers busy in Philharmonic Hall for as long as a year after opening night. Furthermore, he stated that no other hall had as much built-in sonic flexibility. Meanwhile the controversy hovered over Philharmonic Hall like the 106 acoustical "clouds" above the audience and orchestra.

As expected, critics drew comparisons between Philharmonic Hall and London's Royal Festival Hall, the forerunner of the modern concert halls. (It is interesting to note that Mr. Hope Bagenal, the acoustical consultant to the builders of Royal Festival Hall, was engaged by Lincoln Center to advise on Philharmonic Hall.) Philharmonic Hall generally came off better than its English cousin, although in point and descriptiveness the opinions were remarkably close.

"The double basses simply cannot be



Royal Festival Hall, London.

heard." (Leopold Stokowski on the Royal Festival Hall)

"Either there is amplification or there is something wrong. I haven't heard a cello or a double bass yet." (Virgil Thomson on Philharmonic Hall)

* * *

"The lack of bass in the hall is the most serious problem." (Dr. Leo L. Beranek on Royal Festival Hall)

". . . a decided lack of bass. . . Cellos and basses do not seem able to carry their weight." (Harold C. Schonberg, *The New York Times*, on Philharmonic Hall)

* * *

"The fault is that the hall is lacking in resonance. . . One never gets the feeling of a tremendous sound of a resonant chording. The part writing is always too clear when chordal climaxes are desired." (Sir Malcolm Sargent on the Royal Festival Hall)

"Sound was too dry, resonance was almost completely lacking, and low strings could scarcely be heard." (H. C. S., *The New York Times* on Philharmonic Hall)

* * *

"The back stalls under the grand tier are to be avoided. . . here it seemed that a thick blanket had been suspended between orchestra and audience, and the resultant sound had no more 'stage presence' than has the seedy cacchination of an inferior phonograph." (Geoffrey Sharp *Music Review*, May 1951 on the Royal Festival Hall)

"In the loges and in the extreme back of the hall, the sound thins out a bit; and because of the lack of bass, the effect is not unlike that of a high-fidelity outfit with the bass control out of the circuit." (H. C. S., *The New York Times* on Philharmonic Hall)

"Two kinds of music suffer the most; the elusive, atmospheric piece, and the sumptuous late Romantic scores of Wagner, Strauss and Rachmaninoff." (Desmond Shawe-Taylor, *New Statesman and Nation*, on the Royal Festival Hall)

"The concensus is that the hall is best for intimate music, where the clarity of acoustics helps quiet sounds along." (*The New York Times* on Philharmonic Hall)

* * *

"The acoustics are first-class with regard to clarity, in fact, frighteningly so." (Sir Malcolm Sargent on the Royal Festival Hall

"In this hall the sound is metallic and tinny. There is no warmth." (Leopold Stokowski on the Royal Festival Hall)

"To many auditors, clarity rather than richness of sound seemed the chief tonal characteristic of the hall." (Ross Parmenter, *The New York Times* on Philharmonic Hall)

* * *

"At Festival Hall today, even after some changes, (the reverberation time) stands at 1.5, and when there are standees, (it) drops to 1.4." (Howard Taubman, *The New York Times*, May 11, 1958 on the Royal Festival Hall)

"There is every reason to believe the hall will be properly tuned. . . but there is also every reason to believe that it will be a sharp, clear, dry auditorium rather than a

mellow one." (H. C. S., *The New York Times*, on Philharmonic Hall)

* * *

The above criticisms would seem to indicate that Philharmonic Hall and Royal Festival Hall have common traits—bass deficiency, lack of resonance, irregular distribution of sound. However, the New York hall does not seem to suffer from the lack of homogeneity noted by most critics of the Royal Festival Hall:

"The voices of individual instruments often seem isolated. . . You hear every sound made on stage—not only the sounds meant to be heard but even the turning of the pages and the accidental touch of bow against music stand." (Howard Taubman, *The New York Times*)

"One is inclined to hear each instrument as a separate entity." (Alec Robertson, *The Gramophone*)

Dr. Beranek's reply to the critical reception of Philharmonic Hall is to move panels, lower or raise clouds, experiment with risers, replace screens, and otherwise alter reflective surfaces. One concert-goer (Seymour Solomon, President of Vanguard Records) recently proposed a more drastic method of improving the auditorium's acoustics in a letter to *The New York Times*:

"An educated guess would be that adjusting sound-reflecting panels will not alter the basic sound quality, and that nothing short of structural alteration will suffice. To be considered is the possibility of constructing a more resonant flooring under the orchestra to reinforce and amplify the bass response of the instruments."

As of this writing, acoustics at last are taking second place to music in the review columns. Meanwhile the tuning continues. What will tomorrow bring? More bass, better distribution of sound? Smoother frequency response? Whatever the outcome of future adjustments, Philharmonic Hall, like Royal Festival Hall, promises to remain controversial. Æ

RECOMMENDED READING: "Music, Acoustics & Architecture," Leo L. Beranek; John Wiley & Sons, New York. $17.50

LETTERS

(*from page 6*)

Condenser Microphone Matching

(*The following letter is reprinted from last month with the inclusion of two paragraphs which significantly add to its meaning.*)

SIR:

The amplifier in all professional condenser microphones is in itself basically an impedance-matching device; it converts the extremely high diaphragm/grid impedance (approximately 180 megohms) to a balanced low-impedance line suitable for long cable runs. It is by nature a voltage amplifier and is, therefore, incapable of any power output. The impedance that is listed in the European specifications, usually either 200 or 50 ohms, is the source impedance looking back into the microphone output transformer. If the transformer load is improper, it will re-

flect back into the plate circuit of the tube and shift the operating point to a non-linear portion of the curve. This transformer should never look into an impedance less than 5 times the source value. Since American input transformers do not have 1000-ohm strapping, these microphones can never be operated with a 200-ohm source impedance. They should always be strapped for the 50-ohm impedance.

In order for the console preamplifier input transformer to see the nominal impedance in use today (150/250), it is necessary to insert building-out resistors in the legs of the microphone output transformer. These should be in the order of 60–75 ohms so that the total impedance seen by the preamplifier input transformer is in the order of 200 ohms.

This modification has been included in most all European condenser microphones imported through regular channels for the past two or three years. Anyone that is operating microphones older than this would be well advised to perform these modifications in order to reduce high-frequency distortion.

The problem of overload of the console preamplifier and the internal microphone amplifier due to close-miking techniques has only one satisfactory solution. This is an integral attenuator in the microphone itself between the capsule and the preamplifier grid. While padding of the microphone line at the console input will prevent overload after this point, only the above mentioned type of attenuator will protect the microphone itself.

ALBERT B. GRUNDY
International Electroacoustics, Inc.
333 Sixth Avenue
New York 14, New York

And Still More

SIR:

I am flattered by the interest and comments generated by my article "A condenser microphone mixer" in the October issue. It is regrettable that they have been made, in large part, because of a termination error (200-ohm source rather than 50 ohms) and as a result, the major philosophy of my design has been missed. Some degree of clarification is obviously required. First, let me say that while the schematic was obviously in error and *implied* an impedance-matching connection, the text belies this approach by the very terminology employed: "In order to prevent overload *within* the microphone preamplifiers . . ." That the microphone amplifier should work into a load impedance considerably higher than its source impedance is not open to conjecture and I wholeheartedly agree with Mr. Temmer and Mr. Grundy.

The manner of accomplishing this requirement, however, is the subject for controversy, and is, in itself, the basis for my design. The input transformer of the standard console is normally employed with an unloaded secondary and exhibits a frequency discriminative response when fed from a source other than the specified nominal impedance. This response varies with the individual transformer employed, of course, but it can be generally stated that the high-frequency peaking as a result of "undeterminating" the input is unsatisfactory and can run as high as 5 db. This condition is satisfied by a resistive network between the mike and transformer which allows the source to "see" its proper load while simultaneously providing the necessary input impedance for the transformer. With respect to the unloaded-secondary condition, Mr. Temmer is quite correct. The loaded secondary of my design does not present the same problem and allows the mike to feed directly to a *higher* input impedance (Ref. my letter November issue) without an appreciable peak.

It should be obvious, therefore, that a resistive network is not only *not required* for proper performance, but the attendant loss of approximately 12 db will render this mixer unusable from a sensitivity standpoint, and also, will negate any flexibility gains from this design. I, therefore, reiterate the recommended ideal input termination for my design: The Neumann U-47 microphone should be strapped for 50-ohm impedance and fed *directly* to an input transformer having an input of 250 ohms and a secondary of 100K ohms that is loaded with a 100K potentiometer.

WILLIAM G. DILLEY
514 E. Avery St.,
San Bernardino, Calif.

SPEAKERS

(*from page 22*)

3. H. F. Olson, "Elements of acoustical engineering," D. Van Nostrand Co., Inc. New York, p. 142, 1957.
4. I. Wolff, L. Malter, "Sound radiation from a system of vibrating circular diaphragms," *Phys. Rev.*, 33, 1061, 1929.
5. R. L. Pritchard, "Mutual acoustic impedance between radiators in an infinite rigid plane," *J. Acous. Soc. Am.* 32, No. 6, 730, 1960.
6. H. M. Tremaine, "All about crossover networks," Howard W. Sams & Co., Inc., New York, 1960.
7. J. F. Novak, "Performance of Enclosures for low-resonance high-compliance loudspeakers," *J. A. E. S., No. 1*, 29, 1959.

ATTENUATOR

(*from page 23*)

faced is finding some resistors of the values shown. The best way is to select them, using a Wheatstone bridge, from a large stock of 5-per-cent resistors. This is what the author did. Of course not everybody has access to a bridge The next best thing would be to use the nearest 5-per-cent value without attempting to bridge them. Actually, this can be quite good in some cases since the manufacturers usually hold a tighter tolerance than 5 per cent on these resistors. A range of 3 per cent is what you usually find but, of course, you can't depend on it. Also, not all the exact values you need fall close to a 5-per-cent value, either. If you want a 1-per-cent attenuator and don't have a bridge you will just have to invest in a supply of 1-per-cent resistors. These can be obtained from any good electronic wholesaler. Be sure to get deposited carbon and not wire wound. Although the latter can have a higher wattage rating than the carbons, ½-watt units are more than sufficient for home use. For example, ten volts rms across 600 ohms is only 0.17 watts. In general, wire-wound resistors have a poorer frequency response than the equivalent carbon. Thirty ½-watt 1-per-cent deposited-carbon resistors will cost you about $10 if you remember to get a quantity discount.

Selected 5-per-cent resistors, then, are a better deal if you can borrow a bridge. There is one catch, though: if you aren't careful when you solder them in you can increase their value over what you measured by up to 2 per cent—these resistors are sensitive to overheating. So leave lots of lead length when you solder and use a heat sink as well. Long leads won't hurt anything and can make as nice a looking package as if you cut them short.

A tip on bridging. The heating sensitivity of carbon resistors can be used to good advantage if no particular resistor happens to fall close enough to your value. Simply choose one a few per cent low and heat the leads(s) near the body. Apply heat with discretion and proceed in short steps, always measuring afterwards. This is a good, quick way to set the value.

A more common way is to file a notch into the resistor. This is usually more trouble but can raise the value much further than heating can. I always used staking lacquer to seal the cut but this will raise the resistance as soon as it fills in. A little experience is in order here, and many trials and errors, too, before you will have perfect results.

As a general rule, always work the resistor back and forth in the bridge before removing. Sometimes the value is

intermittent and this check will show it up.

If you like, a more modest version can be built simply by leaving out sections. This is quite all right since every pi section is complete in itself. Rearrangement in any desired order, addition or subtraction of attenuation steps can thus be carried out since everything is completely bilateral. Just remember that the attenuator, whether one or more sections, must always be loaded with an *external* 600 ohms on both ends. Usually signal generators are this impedance but scopes are not. Place a 600-ohm resistor across the end which feeds the scope. This will ensure that whatever attenuation setting you use will be accurate. Additional values of attenuation can be calculated from the following formulas if you so desire: (Refer to *Fig.* 2.)

$$R_1 = 600\frac{A+1}{A-1} \qquad R_2 = 600\frac{A^2-1}{2A}$$

Here, A is the current ratio from input to output (always greater than unity). Choose the desired attenuation in db, look up the current ratio in any standard four-place decibel chart, and substitute in the formulas.

Example: Suppose 10 db was your choice. A then is 3.1623; R_1 is 1155 ohms; and R_2 is 854 ohms.

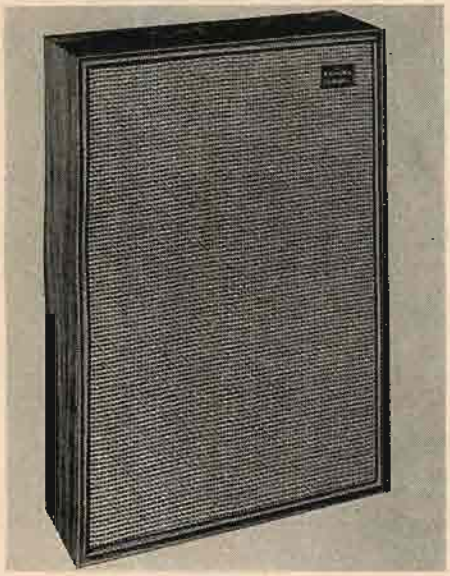
Don't leave the attenuation string floating; ground it to the plate on which the switches are mounted. Hum pickup can be a problem with 40 db or so in the line. A shield over the bottom is a good idea as well and keep a reasonable amount of spacing between switches. Stray capacitance isn't too much of a problem but there isn't any point in taking chances. I know one person who shielded each individual attenuator switch with a separate can around it. This is a good idea if you are really worried about stray capacitance. For my part, I have found that a 1.5-in. spacing or so is sufficient with the resistor bodies above the switch. Other than this there are no special precautions to be taken with the layout. Connecting wires can be loose or point to point as desired.

As for the switches themselves, any good quality dpdt toggle switch can be used. I prefer aircraft type switches, JAN ST52N, for their reliability. There is nothing more aggravating than to throw the switch and have it give intermittent action or partial closing. However, these can be 75¢ more than other kinds so you can save money if you have to by buying non-JAN parts.

All told, the cost should run between $20 and $30. The breakdown is as follows: One mounting plate, $1.23; ten switches, $9.10 to $15.10; 30 resistors, $6.20 to $9.90; miscellaneous hardware, $3.00. When this is compared with commercial attenuators of 3 to 6 times the price it becomes well worth while to build your own. Æ

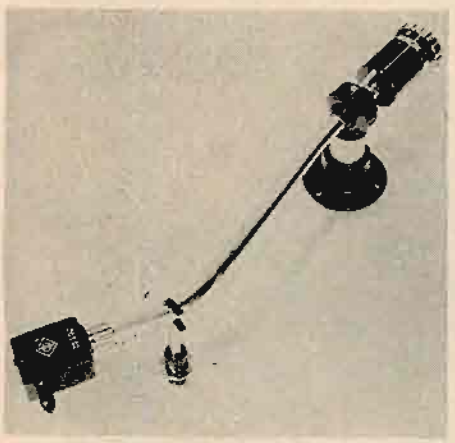
NEW PRODUCTS

• **Slim-Line Speaker System.** The Regina 200 is among the first of the Electro-Voice loudspeaker systems to be produced with an oiled-walnut finish. It has trim modern lines that will blend with virtually any furniture style or room decor. The Regina was developed in answer to demands of discriminating listeners for a system equal in performance to the popular Electro-Voice compact low-resonance systems, but of minimum depth. Less than 6-in. deep,



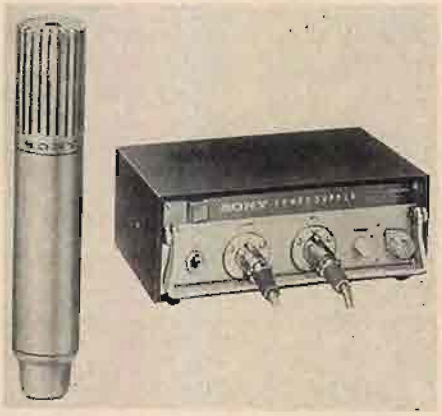
this system delivers performance identical to that of conventional-dimension systems and may therefore be used for monophonic sound or paired for stereo reproduction with another Regina or with the E-V Leyton 100. The Regina is a multi-way system with electrical crossover at 800 cps to a 5-in. dynamic cone-type tweeter, mounted in a totally isolated chamber to prevent interaction with rear wave pressure of the high compliance 10-in. woofer. Electro-Voice, Inc., Buchanan, Mich. **M-3**

• **Integrated Tone Arm and Cartridge.** The new improved Neumann Professional Dynamic Stereo Cartridge DST-62, successor to the DST, is now available with a matched tone arm, the Model STA-12. The Neumann DST-62 incorporates an improved metal underside in place of the



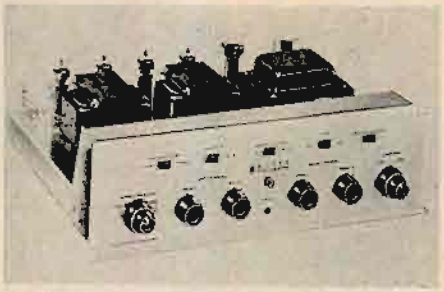
rubber of the previous model which tended to deteriorate in use. It is sealed against dust and dirt. The unit operates with all quality preamp inputs and may be used with the SME, ESL 310/N, and EMT turntable tone arms in addition to the STA-12 tone arm. The STA-12 keeps extraneous resonances at a low level through an improved, special rubber damping which separates the arm from the counterweight. An integral calibrated gauge permits adjustment of the tracking force from 0 to 7 grams. The DST-62 moving-coil cartridge is manufactured by the Georg Neumann Laboratories of West Berlin, Germany, producers of professional recording and broadcasting equipment for over thirty years. The DST-62 cartridge and STA-12 arm are distributed throughout the United States and Canada by Gotham Audio Corporation, 2 W. 46th St., New York 36, N. Y. **M-4**

• **Miniature Condenser Microphone.** A New miniature Sony condenser microphone is now being marketed to the broadcast, recording, and entertainment fields by Superscope, Inc. The Sony C-17B microphone's compact size (⅝-in. diameter × 3¾-in. length) and directional characteristics (cardioid pattern with 25-db front-to-back sensitivity) makes this microphone ideal for broadcasting, recording, and live performances. The microphone diaphragm is constructed of a special plastic material that is processed to a thickness of only



0.006 mm and coated on one side with pure gold, using a vacuum process that applies the metal to a thickness of 0.0003 mm. Because of the highly specialized process of diaphragm manufacture, the Sony C-17B has a frequency response of ±2 db from 20–15,000 cps. The power supply included with the microphone, provides both low-frequency four-position step attenuation and high-frequency cutoff. The Sony C-17B condenser microphone is priced at $299.50 complete with power supply, carrying case and 30 feet of connecting cable. Superscope, Inc., 8150 Vineland Ave., Sun Valley, California. **M-5**

• **30-Watt Stereo Amplifier.** A new 30-watt stereo amplifier, moderately priced at only $139.96, the H. H. Scott Model 200 offers design features and flexibility usually associated with much more expensive Scott equipment. The heavy-duty transformers provide full power throughout the usable



audio range and more than enough power to drive most popular speaker systems. A headphone output is located on the front panel and a tape monitor switch and special inputs and outputs are included for the tape recording enthusiast. The chassis is of electrolytic aluminum for maximum heat dissipation and minimum hum. A derived center-channel output is included to drive a power amplifier for extension speakers. A high-gain input allows utilization of all popular magnetic stereo cartridges. IHFM power rating is 15 watts per channel; IM distortion is 0.5 percent; harmonic distortion 0.8 percent; hum and noise – 70 db. Dimensions are 15½-in. wide by 5¼-in. by 13¼-in. deep, in an accessory case of either walnut, mahogany, or leatherette-covered metal. H. H. Scott, Inc., 111 Powdermill Road, Dept. P., Maynard, Massachusetts. **M-6**

• **Electronic Two-Manual Organ Kit.** The Heath Company proudly announces an exclusive kit version of the new Thomas transistor two-manual organ for just $329.95. A sophisticated instrument, the kit version features the qualities of the factory assembled instrument: 1. Ten organ voices—upper manual contains Trombone, Reed, Flute, Oboe, Cornet, Violin and the lower manual offers Saxophone, Horn, Viola, Diapason; 2. variable bass pedal volume control; 3. manual balance control; 4. variable vibrato; 5. standard

expression pedal; 6. 13-note heel and toe bass pedals; 7. overhanging keyboards; 8. beautiful walnut cabinet; 9. 20-watt peak-power amplifier and speaker; 10. compact size—34½-in. high, 39¾-in. wide, 21½-in. deep; 11. transistorized. A free copy of the Thomas "musical fun" book is included which shows how to play the organ and how to read music. Also available is the Thomas Self-Teacher Recorded Lesson Plan—a complete course of 48 lessons on four 12-in. LP records plus a music book in a beautiful gold-embossed, white leatherette album for only $19.95. Heath Company, Benton Harbor, Michigan. **M-7**

• **FM-AM Stereo Receiver.** A new 30-watt FM-AM stereo receiver was introduced by Bogen Communications Division of Lear Siegler, Inc. The new unit, Model RP230, is said to have a frequency response of ±1 db from 20 to 20,000 cps and an FM sensitivity of 0.85 μv for 20 db of quieting. The new model features Bogen's "Stereo-Minder" indicator which lights when the

station is broadcasting in FM stereo, electronic-eye tuning, a special tape recorder filter which eliminates beeps or whistles when taping off the air, and Bogen's dis-

Scott Stereo Tuner Kit Wins Rave Reviews from every Leading Hi-Fi Expert!

Just one year ago Scott introduced the LT-110 FM Stereo Tuner Kit. High Fidelity Dealers built this superb kit themselves, examined its many features, and recommended it without reservation. Enthusiastic kit builders deluged us with mail. Now the verdict is in from all the leading technical experts. Never before in the history of the industry has a single kit received such unanimous praise. We reprint a few excerpts below.

from POPULAR ELECTRONICS

"No commentary on *Scott Kits* would be complete without first mentioning that this company pioneered new areas in the hi-fi kit market and brought forth several (then-radical) innovations. One of them continues to fascinate all purchasers of a *Scott Kit* — the full-color instruction manual. . . . Scott also pioneered the Kit-Pak — a shipping container which serves as a temporary workbench and storage box . . . a test model of the LT-110 was wired at POPULAR ELECTRONICS in just under five hours. Another 40 minutes was used for careful alignment and the tuner was "on the air." . . . The LT-110 met or exceeded all the manufacturer's detailed specifications on sensitivity, distortion, output level, a.c. hum, and capture ratio . . . the audio response is excellent, being within ± 1 db, from approximately 20 to 16,000 cycles. . . . Channel-to-channel crosstalk is particularly excellent both in terms of uniformity and the fact that it holds up well above 10,000 cycles. . . . Frequency drift of the LT-110 from a cold start is extraordinarily low — less than 5 kc. The a.c. hum level (referred to 100% modulation) is low and exceeds the manufacturer's rating by 5 db. . . . It's difficult to imagine a kit much simpler to assemble than the LT-110. The full-color instruction book climinates just about the last possible chance of wiring errors. . . . From a plain and simple operational standpoint, the LT-110 *works well and sounds good.*"

Popular Electronics, Oct. 1962

from ELECTRONICS WORLD

"Construction time for the unit we tested was 6½ hours, without alignment . . . in listening tests, the tuner showed its high useable sensitivity to good advantage. Using an in-door antenna which produced marginal signal to noise ratios on most other tuners we were able to get noise-free, undistorted stereo reception. It's quite non-critical to tune, hardly requiring the use of its tuning meter."

Electronics World, Nov. 1962

from AUDIO

"The LT-110 (is) so simple to build that we unhesitatingly recommend it for even the novice. . . . We found that the useable sensitivity (IHFM) was 2.1μv . . . a fine stereo tuner and an unusually easy kit to build."

Audio, April 1962

from RECORD GUIDE

"It seems to me that every time I turn around I am building another of H. H. Scott's kits. And each time I end up praising the unit to the skies.

The Scott instruction books should be a model for the industry. They feature full-color, step-by-step, illustrated directions. Each resistor or other component is shown in the progressive phases in its color code and in its proper position. . . .

There is no audible drift in the LT-110 whatever. You can shut the tuner off on a station and pick it up the next day, perfectly tuned, without touching the tuning dial. No AFC circuits are included in this tuner and none are needed.

This tuner kit has to be ranked on the same plane as H. H. Scott's factory-wired units. It is an excellent product, and because of its conservative parts very likely to give long, trouble-free service."

American Record Guide, Sept. 1962

Now Sonic Monitor* Added

Scott's unique Sonic Monitor has now been added to the LT-110. This foolproof stereo signaling device tells you audibly when you are tuned to a stereo station. Just turn the switch to "Monitor", and tune across the dial. When you hear the monitor tone from your speakers you know you've tuned to a station broadcasting new FM Stereo. Now switch the Monitor knob back to "Listen" to enjoy perfect stereo sound.

LT-110 $159.95 (slightly higher West of Rockies.)
*Patent Pending

SCOTT

H. H. Scott, Inc., 111 Powdermill Rd., Maynard, Mass.
Dept. 35-12
Rush me complete details on your LT-110 FM Stereo Tuner Kit and other superb Scottkits. Be sure to include your new free Stereo Record, "The Sounds of FM Stereo" showing how new FM stereo sounds, and explaining important technical specifications.

Name_____

Address_____

City_____ State_____

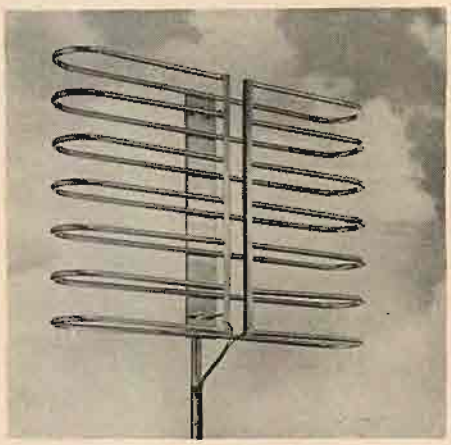
Export: Morhan Exporting Corp., 458 Broadway, N.Y.C.
Canada: Atlas Radio Corp., 50 Wingold Ave., Toronto

tinctive brushed gold panel. Model RP230 is priced at $249.95. Metal enclosure EN7, $12.95; Walnut enclosure, WEI, $27.95. All prices slightly higher in the West. Bogen Communications Div. of Lear Siegler, Inc., Paramus, N. J. **M-8**

● **Low-Cost Dynamic Microphone.** A new low-cost omnidirectional microphone, the Shure Model 575 "Versadyne," features smooth response from 40–15,000 cps and is intended for general public address, home recording, and call system use where both performance and economy are important. It has a smartly styled, rugged Armo-Dur body with satin anodized cap and stainless steel grill. Small in size and lightweight, the "Versadyne" is adaptable to hand-held, stand-mounted, or lavalier use. The "Versadyne" is available in two models: The

Model 575S features high impedance and high output making it ideal for use with practically all public address amplifiers where only a moderate length of cable is required; the Model 575SB is a low-impedance model designed for use in installations where long cable lengths are required, or for use with transistor amplifiers where a medium or low-impedance microphone is required. Both models feature a slide-to-talk locking switch. Accessories furnished are stand adapter, lavalier bracket, and cord assembly. List price for the Model 575S is $24.00; Model 575SB is $21.00. Additional specifications are as follows: Frequency response is 40–15,000 cps; output level of the Model 575S is −58 db (0 db = 1 volt per microbar), and of the Model 575SB is −62 db (0 db = 1 milliwatt per 10 microbars); impedance of the Model 575S is 100,000 ohms and of the Model 575SB is 150–250 ohms; dimensions are 4¾-in. long × 1¼-in. diameter; the weight is 5 oz. Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, Illinois. **M-9**

● **7-Element FM Antenna.** A new 7-element FM antenna designed for multiplex reception, the new Mark "Stereo 7" can be used indoors as well as outdoors. The Mark "Stereo 7" is omnidirectional and is horizontally polarized so that it is not affected by guy wires. There are no insulators to deteriorate. The compact, rugged



aluminum elements resist oxidation and give long life. The antenna is 30-in. wide, 22-in. high, 5½-in. deep. Comes complete with all hardware for easy mast mounting. B & K Manufacturing Company, Division of Dynascan Corporation, 1801 West Belle Plaine, Chicago 13, Illinois. **M-10**

SERIES FEEDBACK

(*from page 34*)

have treated the returned feedback signal deserves just a little mathematics. We put in some signal E and get out, first time round, just μE: we send back to the input $\beta\mu E$, so that we now get out the delayed signal $\mu \cdot \beta\mu E$. Back to the input goes $\beta\mu \cdot \beta\mu E$ to give a second delayed signal $\mu \cdot (\mu\beta)^2 E$. In fact the total output becomes:

$$\mu E\,(1 + \mu\beta + (\mu\beta^2 + \ldots)$$

This term in the parentheses is equal to $[1-(\mu\beta)^n]/(1-\mu\beta)$ and n is going towards infinity so that since $\mu\beta$ contains a delay term we get back to $\mu/(1-\mu\beta)$ provided that we can forget about the unexploded bomb in the form of $(\mu\beta)^n$. If you want to go into the mathematics more deeply you will find that series like the one above are discussed in the standard textbooks, such as "Methods of Mathematical Physics," H. and B. S. Jeffreys, (Cambridge University Press, 1946). For our purposes, however, it is more than sufficient to notice that the classical feedback equation has got this hidden trap of time delay, without which the term $(\mu\beta)^n$ would be significant now and with which the leading edge of transients is uncontrolled by feedback.

The practical engineer may have become impatient with all this. He always shapes his feedback-path response so that there is no ringing when a square wave is applied. Surely that will be good enough for anyone. Unfortunately this is not so. Let us consider a rather simple design in which the output transformer has exactly the response we need for the whole amplifier, rolling off nicely at the highest frequency we wish to hear so that noise above this frequency will not be pumped out to cause intermodulation in the loudspeaker or a deflection on the customer's meter. The amplifier structure which precedes the transformer will then be designed to give a flat frequency re-

sponse too and very low distortion. When we combine the amplifier and the transformer we get no spike on the leading edge and we believe all is well. But let us, just for the sake of having numbers, take the transformer cut-off frequency as 10,000 cps so that it will probably be 40 db down at 100,000 cps. If the amplifier produces a spike lasting 5 microseconds, which is a half cycle of 100,000 cps, and this spike is 10 times the normal signal amplitude we just will not see any trace of it after the transformer. Inside the amplifier, however, we have got this huge spike. Since we assume that the transient signal is one which drives the amplifier fully, the spike represents a fantastic overload.

Of course, it only lasts 5 microseconds and my poor old ears cannot detect any intermodulation which is so short. I have raised before the question of whether we are designing equipment to entertain the local bats and for my part if the bats want music they can build and pay for the equipment themselves. The only trouble is that it isn't the fall which hurts, but the bruise. When the spike hits the grid of a tube near the end of the amplifier we shall drive a good deal of grid current through the grid-cathode diode and leave the coupling capacitor well charged. It will be a long time-constant circuit, because it is chosen to give good low-frequency response. The amplifier will become paralyzed for a time which is quite long enough to make itself known. We shall get the same result with transistors though we may, for circuit reasons, find that we cannot pump quite such a paralyzing charge into the capacitors.

The example taken is an artificial one and the reader may therefore be tempted to think that the problem will only appear in these artificial conditions and will not worry him when he is building a practical amplifier. In a transistor amplifier, however, we shall normally have a very restricted frequency range in the output transistors while the front end of the amplifier, using small transistors, will have a much more extended frequency response. The slow response of the output transistors will provide most of the delay in the forward amplification path but will prevent the spikes getting through to the output. The preamplifier will be overloaded, however, in just the way we have been discussing.

Even without a transformer we normally find that we have an even chance of designing our amplifiers to produce this effect. When we design a three-stage amplifier we know that if we want a reasonable amount of feedback we must design for either one narrow-band stage and two wide-band stages or one wide-band and two narrow-band stages. Nothing in the theory of stability

gives us any reason why we should choose one of these arrangements rather than the other and nothing in the theory tells us why they should be in any particular order.

It is here, however, that our salvation lies. The input stage of an amplifier can usually handle a very much larger signal than will ever be applied to it and certainly it does not need very much extravagance in design to make sure that this is the case. If this stage is made to be a narrow-band stage it will prevent the passage further into the amplifier of the transient spike and will save the later stages from overloading. There is a good deal to be said in favor of making the input circuit, before the amplifier itself, restrict the bandwidth to the extent permitted. What is certainly needed is some way of making sure that in the interval before the signal has had time to get through the amplifier and back round the feedback loop the input cannot have risen to the point where overloading will take place.

An experimental study of this effect is not very easily carried out without fairly elaborate equipment. In tube circuits we might think that an oscilloscope connected at various points in the amplifier would do the job, but unless the oscilloscope has a very low capacitance it will disturb conditions in the circuit and may obscure the whole issue. In particular when we connect it in our wide-band circuits we may narrow the band-width to the point where the amplifier becomes unstable.

How important is this effect in the practical use of amplifiers? After all we rarely have to deal with transients representing anything like the full output. The practical situation is that we are using much of the grid bias for the low-frequency components of the sound and we must consider that the transient will be added to this. Since we are thinking in terms of factors of 10–30 times, corresponding to 20–30 db of feedback, realistic transient signals can make a firm bid for all the grid bias if added to the other signals can produce the overloading we fear.

This suggests that we might examine the amplifier by a sort of intermodulation test. If we apply a sustained low-frequency sinusoidal signal and a keyed high-frequency signal we can filter out the high frequency and see whether the low-frequency sine wave is at all disturbed by the sudden switching on of the high frequency. We must accept a keying click but must watch for a period of paralysis following the switching.

In the long run we will be trusting our ears. If it sounds all right it is all right and there is no point in carrying matters any further. It it does not sound right we start making all the measurements and the steady-state measurements will not reveal this effect at all. That is why it must not be forgotten. Transient distortion is difficult enough to measure, but transient intermodulation gives us the worst of two worlds: it is difficult to identify clearly by listening tests and difficult to simulate or measure. But oh, what an 'orrible noise! Æ

STEREO PREAMPLIFIER

(*from page 38*)

of each of the filter transistors is considerably higher than its d.c. resistance.

With the stereo preamplifier connected to the supply voltage filter the correct supply voltages of the individual amplifier stages can be adjusted by means of the bias potentiometers, starting at the last filter section. For exact results this procedure should be repeated at least once since interaction takes place between the filter elements.

The total power consumption of the entire stereo preamplifier-equalizer unit mounts to $P_{DC} = (-V_{Ca})\ I_{total} \approx 590$ mW. This value is far below that of an equivalent unit employing vacuum tubes, although no special thought has been spent on the restriction of power consumption.

COMPLETE CIRCUIT OF THE UNIT

MEASUREMENTS AND FINAL SPECIFICATIONS

Operating Points

A VTVM with an input resistance of 11 megohms has been used for all d.c. measurements. Since it is not possible to measure direct currents in transistor circuits without upsetting normal operating conditions of the circuit, all direct current values of interest have been determined from voltage and resistance measurements. The exact operating points obtained are: Stage one: $-V_{CC} = 19.0$v, $-V_{CE} = 4.52$v, $-I_C = 0.50$mA. Stage two: $-V_{CC} = 21.0$v, $-V_{CE} = 4.80$v, $-I_C = 1.05$mA. Stage three: $-V_{CC} = 25.0$v, $-V_{CE} = 7.90$v, $-I_C = 8.20$mA.

Note that the values actually achieved very closely approximate the values calculated in advance.

Audio-Frequency Measurements

Test Equipment. The following test instruments were used in measuring the audio-frequency characteristics of the preamplifier-equalizer:

Test Instrument	Heathkit Model
Audio Generator	AG-9A

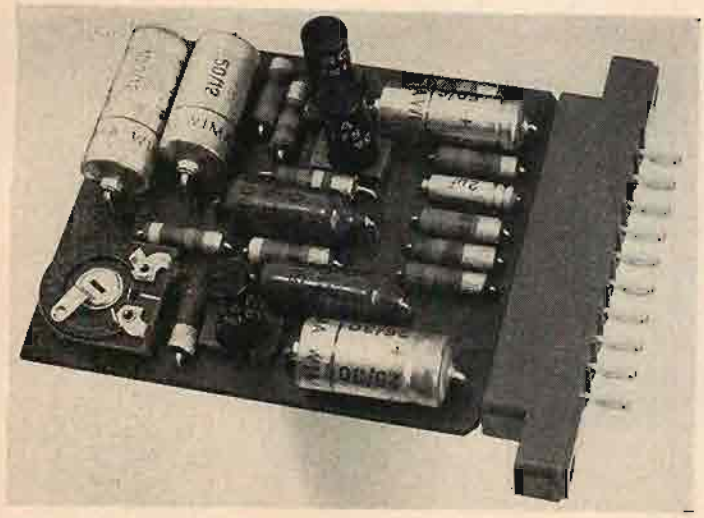


Fig. 8. One of the amplifier modules viewed from the component side of the circuit board.

Harmonic Distortion Meter	HD-1
Intermodulation Distortion Meter	AA-1
Audio-Frequency VTVM	AA-1
Monitor Oscilloscope	IO -30

Measurement of IM distortion was made possible by inserting a RIAA recording-characteristic simulating network between signal generator and preamplifier input.

Audio-frequency specifications.

Characteristics of the individual stages.

Since d.c. coupling is employed between the amplifier stages, only some of their audio-frequency characteristics can be measured directly. It will be seen that the difference between these and the theoretically expected values is negligibly small.

Measured and intended voltage gain figures at 1000 cps, with feedback loop open, are compared in Table II; Table III shows several voltage gain figures with feedback loop closed. Interesting information about the behavior of the amplifier may be gained from critical examination of these data.

First, it will be noted that the voltage-gain reduction due to feedback around the first two stages at low frequencies consists of first-stage gain reduction only. Second-stage gain remains completely unaffected since at frequencies below 50 cps the loading effect of the feedback network is still negligible. With increasing frequency second-stage gain, too, decreases, as expected.

Second, it may seem surprising that the voltage gain reduction is only 10.5 db instead of the anticipated value of about 11.6 db (9 db + 2.6 db, according to previous calculations). This is mainly due to the increase in input impedance of the first stage when the feedback loop is closed. Some input impedance values of interest are shown in Table IV. With

TABLE II

VOLTAGE GAIN AT 1000 CPS, FEEDBACK LOOP OPEN

Voltage Gain	Measured	Intended
g_{vI}	32.8 db	33.0 db
g_{vII}	22.4	23.0
g_{vIII}	4.8	4.0
g_{vtot}	60.0	60.0

TABLE III

VOLTAGE GAIN, FEEDBACK LOOP CLOSED

freq.		25 cps	1000 cps
g_{vI}		22.3 db	9.2 db
g_{vII}	db	22.4	17.0
g_{vIII}		4.8	4.8
g_{vtot}	db	49.5	31.0

TABLE IV

INPUT IMPEDANCE

	freq. (cps)	Input Impedance		Measured	Intended
Without Feedback	25	r_{II}	k ohms	12.9	12.15
	1000	r_{II}	k ohms	13.1	
With Feedback	25	R_I	k ohms	48.0	46.4
	1000	R_I	k ohms	119.0	

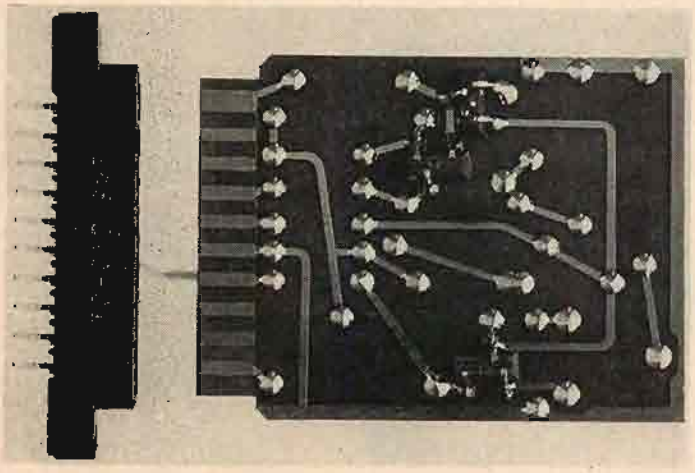


Fig. 9. Amplifier module, etched circuit.

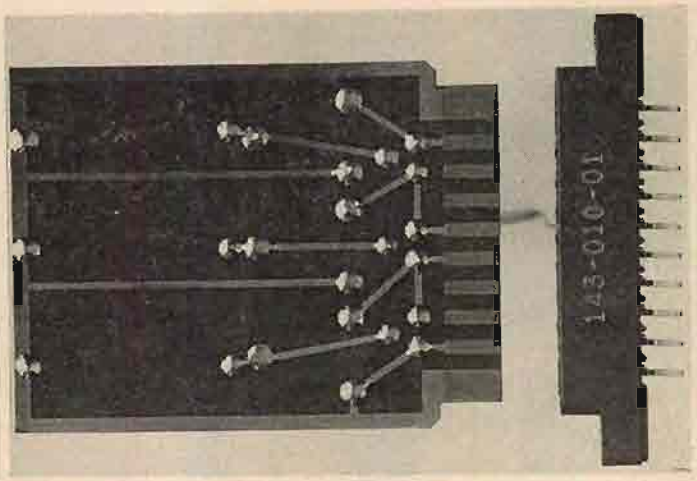


Fig. 10. Ripple filter module, components side.

feedback loop open, the input impedance is nearly independent of frequency. As expected, it increases with frequency when the feedback loop is closed. The close correspondence of measured and calculated values again proves the approximate formulas derived.

Final Specifications of the Entire Unit. The measured audio-frequency characteristics of the preamplifier per channel are:

Input resistance $R_i > 46{,}000$ ohms
(See *Fig.* 6, page 38.)
Output resistance $R_o = 620$ ohms ± 5%
Voltage gain at 1000 cps 31 db
Harmonic distortion (20–20,000 cps)
standard output level
(−10 dbm into 600 ohms)
less than 0.03%
maximum output level
(0 dbm into 600 ohms) less than 0.08%
Intermodulation distortion
(50 and 5000 cps, 4:1)
standard output level less than 0.12%
maximum output level less than 0.28%
Noise output level −83.6 dbm
Signal-to-noise ratio, referred
to standard signal level 73.6 db
Frequency response
RIAA playback curve
± 0.2 db 50–30,000 cps
−1.5 db less than 50 cps
−2.5 db at 10 cps
(See *Fig.* 7, page 38)
Interchannel frequency balance
± 0.5 db 10–50,000 cps
Channel separation
greater than 60 db from 10–50,000 cps
Power consumption about 600 mw

The actually measured specifications of the unit meet or even exceed the previously listed specification.

CONSTRUCTION

Because of the low impedance level of the entire audio circuit and because of the low supply voltages involved the mechanical construction of the preamplifier is not critical in any respect. The small size of the circuit elements employed quite logically leads to etched-circuit board construction.

In common with the other units of the author's stereo system the preamplifier is built as a plug-in unit intended for rack mounting. An aluminum chassis of conventional construction holds the rather heavy electrolytic capacitors. The amplifier itself consists of two separate, but completely identical circuit boards, one for each channel. A third circuit board of similar shape holds the ripple filter circuit minus the supply voltage filter capacitors. A special part of each of the etched-circuit modules is designed

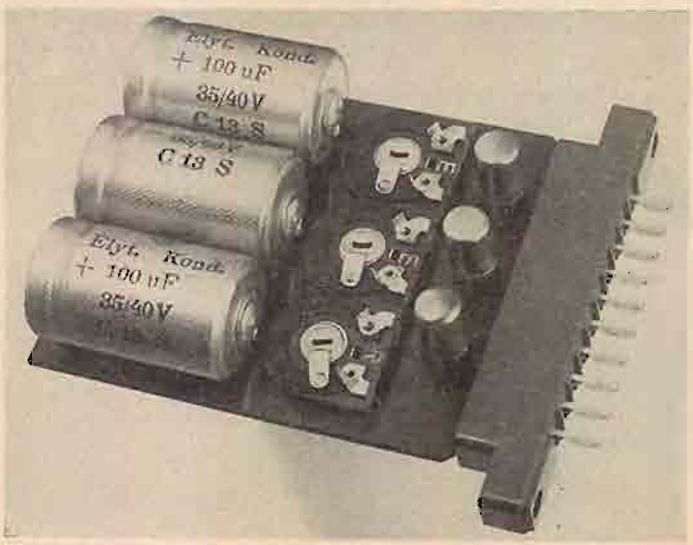


Fig. 11. Ripple filter module, etched circuit.

as a connector which mates with a standard printed-circuit connector (Amphenol 143-010-01). Mounted on the plug-in chassis three connectors of this type provide for electrical connection with the rest of the circuit as well as for mechanical support of the three circuit boards.

All three of the etched-circuit modules are of equal size, that is 1 15/16 × 2 9/16-in. Though possible, further miniaturization was considered unnecessary. The photographs (*Fig.* 8 and 9) show the components side and the etched-circuit side, respectively, of one of the amplifier modules, the ripple filter module is shown in *Fig.* 10 and 11.

It will be noted that some of the components used are of European origin. They may not be available in the United States, but most certainly the American equivalents will be of similar shape and size. However, if completely different components are to be used, the layout of the circuits will have to be changed accordingly.

(*To be continued*)

AUDIO ETC

(*from page 73*)

furnaces, which we "hear" only when they suddenly cease? There is the human total listening-mechanism at work.

(It is possible, a nagging little voice tells me, that there may be some actual noise cancellation in the Jensen-Bauer circuit, roughly akin to that which cancels out noise when stereo is switched to mono. This might combine with the illusionary improvement in signal-to-noise perception. Somebody else can follow this one up.)

Space Control

The Jensen CC-1 is a small and very neat passive control box, inserted in your speaker lines. No power cord. White body, wood frame, five mirror-faced controls, output (phone socket) for two 8-ohm phones. You can switch between phones and speakers and adjust relative levels, though you can't use both at once. (Who wants to?) You can get either ear alone, just for checking, or reverse the channels—in case you've hooked things up wrong or in the unlikely event that RCA Victor has put its violins on the right side by a mistake. You can switch from SPACE PERSPECTIVE to REG (a nice euphemism for straight two-channel, which Jensen quite properly is NOT calling stereo). Also MONO. You have a balance control and a volume control—all of these, of course, operating only on the phones. No effect on speakers, which simply feed through the unit. It takes eight connections in the rear to accomondate power amplifier and speaker leads; you furnish the cables. I just hung on my standard short modular-system connections, polarized male towards the amplifier, female towards the speakers. The whole unit plugs into my system in two seconds.

I note only one side-observation on the CC-1 action. There is these days an unfortunately large variation in efficiency between available brands of phones, even at a uniform stated figure of 8–10 ohms. On the weakest phones I found that CC-1's volume control turned on full was barely enough, with practically all the umph available from a big stereo amp. Could be

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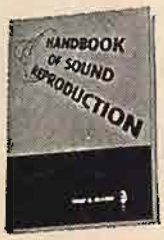

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my ears and my taste for loudness; but I think maybe a slight revision of the matching-up values in the unit, to cut down a bit less, would be helpful.

If you use two different brands of phone, of course, you're in hot water—one is usually louder than the other. I had to match my phones up in roughly equal pairs for communal listening. There's nothing Jensen can do about that short of an extra set of padding units in the box, which would be prohibitively expensive. Solution: use two sets of phones of the same brand. (The Koss phones are so very much louder than most others that perhaps Jensen had to set its values in the present fashion, or risk blowing out a few Koss-equipped ears.)

Jensen sent me a set of their own white-plastic HS-1 phones, to match the CC-1. Soft, dark-grey ear surrounds, tailored to fit the ear. I had tried an earlier pair briefly last spring; these were from later production. Jensen showed me curves (a standard phone measuring technique involving a fixed-size air cavity and a test microphone, simulating an average ear-and-earphone) which indicate that these phones should produce smooth full highs, though as in most phones the bass falls off. With a poor head seal, bass loss is more drastic. I compared Jensen's HS-1, AB style, with the Koss phones, which seem to be the notable competition, and found that indeed the Jensens do have an audibly quite clean and loud high end, and an evident lack of bass, particularly with a loose ear-seal. The Kosses, quite differently, have a loud bass end and lose less of it with an imperfect seal; the Koss highs, on the other hand, show a definite drop and are somewhat colored, though pleasantly, not harshly. At least for my ears.

The Koss type of phone is popular, I think, because the balance of response is a sort that intuitively satisfies the musical ear, providing presence—a realistic sense of being close to the music—and, especially, an excellent bass-to-treble relationship, the falling-off in the highs matching the bass end. I suggest that the Jensen phones, though their highs are full and clean, tend to sound a bit shrill simply because of their relative abundance and the consequent unbalance with the bass. The effect is more apparent than actual, in good part a trick of the ear.

The ear-mechanism, as I say, is dogmatic about these things. Give it over-all frequency balance—first. Then start fussing about clean response.

An ultra-simple way to get the best out of the Jensen phones: just roll off the highs a bit on your stereo amplifier control. Be assured that nothing is lost; a lot is gained. A very considerable drop may be necessary to balance the bass curve, but the results, once you have listened awhile, will be authentically musical.

I suggest a not unflattering parallel between these phones (also others like them) and the small but extraordinary little shoebox speaker system of the KLH Model Eight FM radio. That miniscule speaker has flat highs, same as in the big KLH models. It has astonishing bass for its size, but the lows, even so, aren't quite as big as those of the full-size KLH speaker systems. I find it invariably helpful, thus, to roll off the little speaker's high end, deliberately, 'way down, until a natural musical balance is established. The music sounds better.

The question is—which do you want most? Flat highs (with drooping bass), or good musical sound? The principle applies to Jensen's phones and to a good many others on the market. *AE*

Industry Notes...

• **Altec To Show at World's Fair.** Altec Lansing Corporation has been appointed, by invitation, to participate and display a complete stereo home music system at the New York World's Fair in 1964–1965. The House of Good Taste, Inc., one of the featured exhibits in the forthcoming World's Fair, extended the special invitation, based on the merit of Altec's products, to the company's president, Alvis A. Ward.

• **Concord Distributor Sales Manager.** Donald E. Hassler, Marketing Manager of Concord Electronics Corp., Los Angeles, has announced the appointment of Ted Inahara to the position of Distributor Sales Manager. In addition to his new position, Mr. Inahara will continue in his position as Sales Manager for Hosho of America, Inc., a subsidiary of Concord.

• **Technical Consultant for Elpa.** Charles K. Nostrand, formerly of Audio Consultants, Huntington, New York, has joined the Elpa organization as Technical Consultant. Included in Mr. Nostrand's duties will be those of application engineering and field servicing for the Ortofon professional recording equipment.

• **Gray Chief Engineer.** Chester A. Snow, Jr. has been named Chief Engineer of Gray Research and Development Co., Hartford, Connecticut. Mr. Snow's new duties will center around the design and production of professional tone arms, turntables, equalizers, and slide projectors for industrial use.

• **Fairchild Recording Enters Attenuator Field.** At the recent Audio Engineering Society Convention in New York, Fairchild introduced its new line of professional-type attenuators called the "Lumiten." The "Lumiten" series is the result of Fairchild research in photo-conductive control technology, which has also produced a whole line of studio speech input equipment.

• **Harman-Kardon Initiates "Citation Seminars."** Harman-Kardon, Inc. has announced a series of "Citation Seminars" for consumers in the New York City area to be held during the winter months to acquaint consumers with its Citation line of products. The seminars will be held initially at four dealer locations in the New York City area. Dealers participating are Sam Goody, Airex, Leonard Radio, and Packard.

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SALE ITEMS—tapes—package quotes. Bayla, Box 131-O, Wantagh, N. Y.

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PIPE ORGANS WANTED—AND FOR SALE– Monthly magazine, $2, year; organs—new, used, parts, music. Alden Miller, 3212-34th Avenue South, Minneapolis 6, Minnesota.

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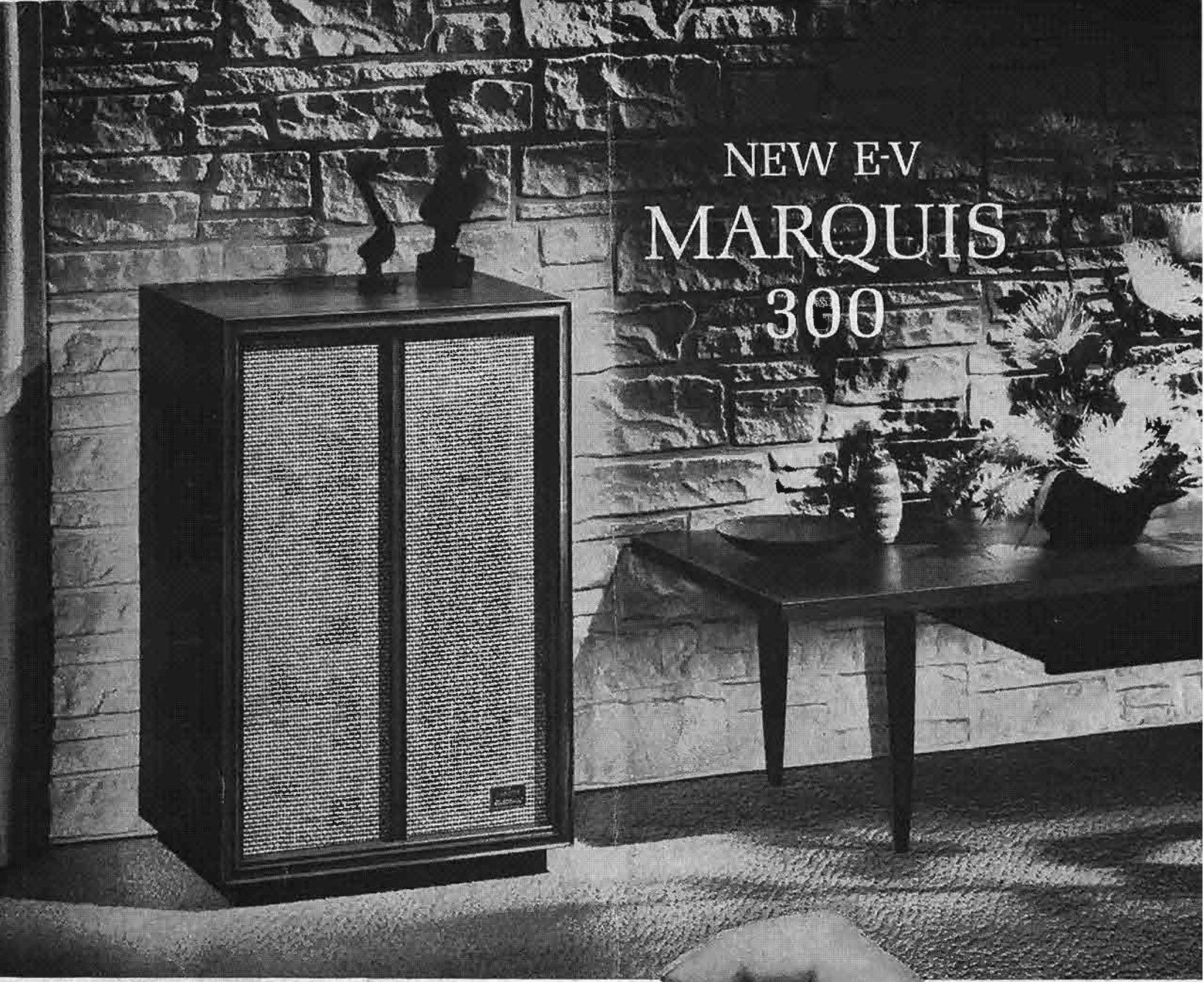

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