AUDIO

JUNE, 1960
50¢

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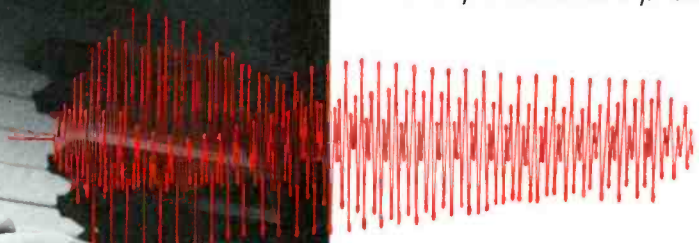
One of a series

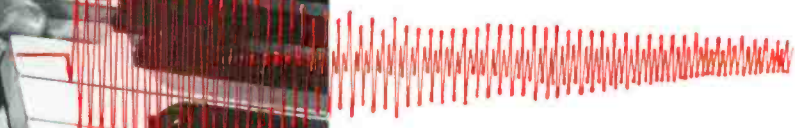
You capture the shading with RCA-7025 . . . .

. . . the low-noise high-mu twin triode for supersensitive preamplification



C below C, 130.81

Shifting overtones give the piano its vibrant ring. Lower register tones, as the first oscillogram indicates, may generate 10 or more perceptible overtones that continually change in relative intensity. In higher registers, as the second oscillogram shows, the struck tone dominates at first, but fades quickly leaving the first octave predominant. The subtlest shadings emerge with utmost clarity when you design your preamp circuits around the RCA-7025.



C above C, 523.25

Developed especially for high-gain resistance-coupled preamplifier stages in top-quality audio systems, this 9-pin miniature twin triode performs with almost imperceptible hum and noise. Hum is minimized by use of a double helical hairpin-type heater in each triode unit. Minimum noise and microphonics are assured by use of an exceptionally sturdy cage structure with short, stiff leads, oversized side rods and newly designed micas.

Result: *average noise and hum voltage for each unit is only 1.8 microvolts rms.* And—this versatile performer operates from either a 6.3- or 12.6-volt heater supply for extra design flexibility.

Characteristics, Class A_1 Amplifier (Each Unit):

Plate Voltage	100	250	volts
Grid Voltage	—1	—2	volts
Amplification Factor	100	100	
Plate Resistance (approx.)	80000	62500	ohms
Transconductance	1250	1600	μmhos
Plate Current	0.5	1.2	ma

Discover a new world of preamp performance with the RCA-7025. For full information on RCA's comprehensive line of audio tubes, check with your RCA Field Representative, or write to *RCA Electron Tube Division*, Commercial Engineering, Section F-91-DE, Harrison, N. J.

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RADIO CORPORATION OF AMERICA

June, 1960 VOL. 44, No. 6

Successor to RADIO. Est. 1917

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

CONTENTS

COVER PHOTO—Ray Wilcox, discriminating stereophonic sound enthusiast and plastics manufacturing executive, chose Barzilay cabinets to enhance his contemporary Hollywood apartment. Installed in the enclosures are: a Garrard RC-88 changer, Fisher 600 stereo FM-AM receiver, two Bozak two-way speaker systems, and a Conrac Fleetwood "De Vinci" television set. The Barzilay 1961 equipment cabinet, 1963 TV cabinet, and two 1962 speaker enclosures, all in hand-rubbed walnut, are shown here. They can be assembled in this type of entertainment center or placed separately throughout the house. Installation by Rudy Stoklos, West Los Angeles branch of Kierulff Sound Corporation; cabinetry by Barzilay Furniture Manufacturing Co. from designs by Jack Benveniste; photo by Fran Hunt.

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AUDIO clinic

JOSEPH GIOVANELLI*

Unloaded Transformer Secondaries

Q. I have seen references as to the consequences resulting from leaving the secondary of an output transformer unloaded while the primary is energized. Why is this so? H. H. Gillman, West Orange, New Jersey.

A. In the previous two columns I discussed the subject of measurements. You noticed that all the measurements which had to do with amplifier performance called for the output transformer to be loaded by a suitable resistor. This was done because inaccurate data would be obtained if it were not. Suppose, for example, that we are interested in measuring power. If all we did was to measure the voltage appearing across an open output transformer, we would have no idea of the power being developed in the secondary winding because no current would flow except the small amount taken by the voltmeter. Power represents work being done, and no work is being done by open-circuited voltage.

Accuracy of other measurements will be impaired because the feedback voltage will be raised beyond the amount which is effective during normal operation of the amplifier.

There is, however, another reason for using this resistor. When a coil is connected to an a.c. source, it draws little current in proportion to that which it would draw if a secondary were wound around this coil and its ends shorted. Then the coil would draw considerable current. The amount of this current would depend upon the design of the coil, the degree of coupling to the secondary, the degree of the short at the secondary, and the voltage fed into the coil—now to be called the primary. (When we placed the secondary coil on the first coil, a transformer was created. We are dealing with that transformer in our imaginary amplifier.) We have said that the coil did not draw much current when the coil did not have a load connected to it by way of the secondary. Even when a secondary is wound on the transformer, we still won't get much current out of the coil until that secondary is shorted directly or until a resistor is connected between the two leads. Even though the current taken by the primary is small when the transformer is not loaded, the voltage can rise very high. When this occurs, the insulation between turns of the coil may break down or the insulation between the coil and the core may break down. Tubes may even arc and be ruined. When the transformer is loaded, however, these high voltages cannot build up, and these dangers can be avoided.

Meter Multipliers

Q. Some voltmeters are arranged to have a sensitivity of so many ohms per volt; others are rated as having a specific input resistance. How are these circuit arrangements brought about? E. B. C., Minneapolis, Minnesota.

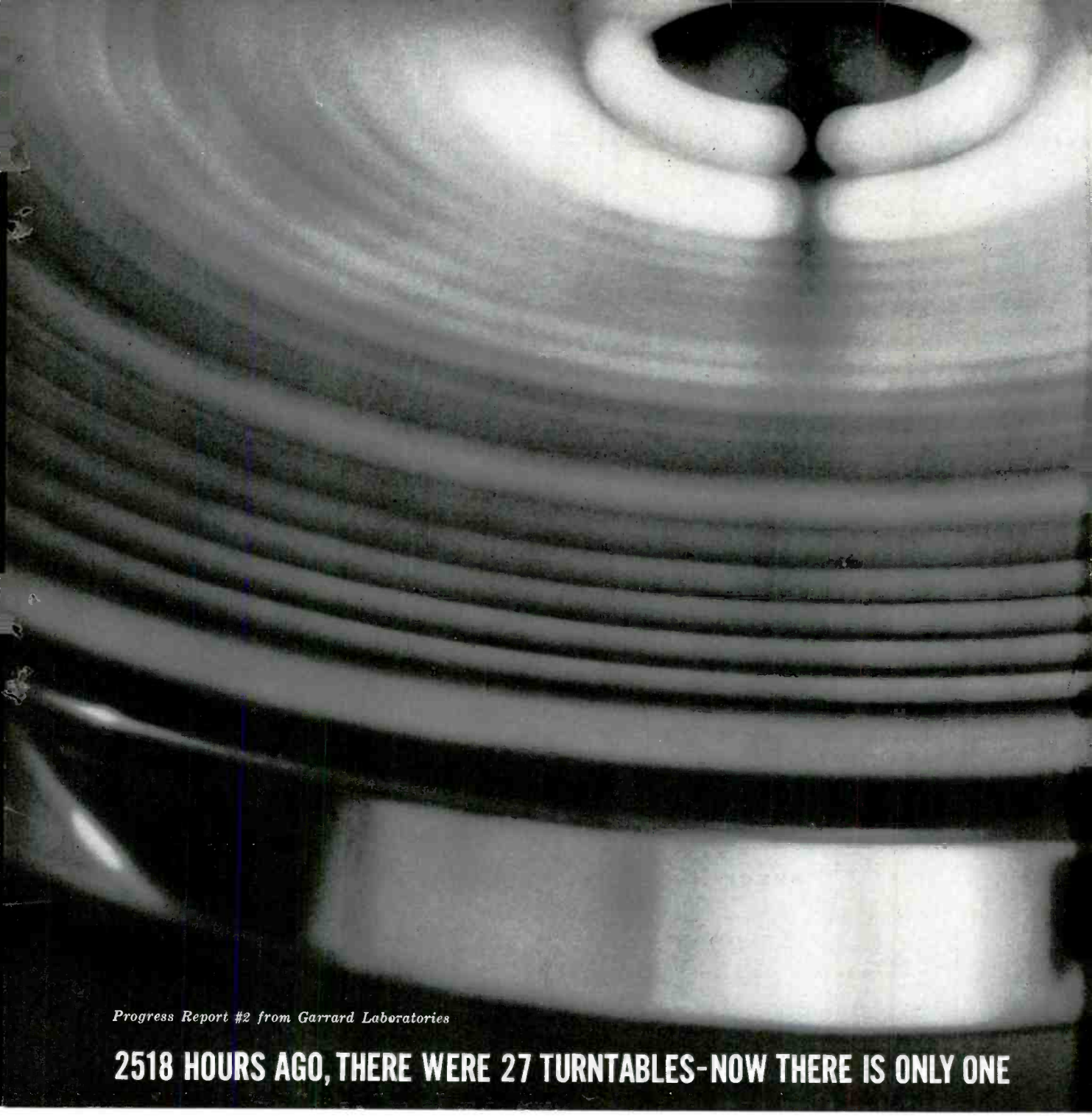
A. What I shall do here is explain the workings of meter multipliers in a general manner in order that this information can be used when working out the details of a specific meter multiplier.

A meter multiplier is a resistance network which extends the range of a voltmeter. Actually, the multiplier is an attenuator because it prevents the actual meter from receiving the full voltage which is placed across the circuit. Even though it is an attenuator, it does make the instrument indicate a higher voltage than that which appears on the meter face, and this reason we can consider this network to be a meter multiplier.

Let us first take the case of the meter whose resistance is so many ohms per volt. Let's take the common 20,000-ohms-per-volt instrument as our sample multiplier and meter combination. Let's assume we are measuring one volt. The meter movement and a 20,000-ohm resistor (actually 20,000 ohms less the resistance of the meter movement) are connected in series across the voltage source to be measured, and the meter then indicates full scale. The sensitivity is then said to be 20,000 ohms per volt.

Suppose that we are now interested in measuring two volts full-scale. We merely connect an additional 20,000-ohm resistor in series with the first one. When the two volts are applied to this series combination, half of the voltage will be lost across the new resistor and the rest will be developed across the original, or basic, meter-and-resistor circuit. If ten volts is to be the second range of the instrument, 180,000 ohms is placed in series with the basic circuit and the total resistance of the attenuator on the second range is 200,000 ohms and represents the required 10-volt

* *3420 Newkirk Ave., Brooklyn 3, N.Y.*



Progress Report #2 from Garrard Laboratories

2518 HOURS AGO, THERE WERE 27 TURNTABLES-NOW THERE IS ONLY ONE

To build a better turntable for tomorrow's Garrard instruments, 27 experimental models were set spinning in a Garrard laboratory. Hour after hour, for all these months, they have been carefully watched and painstakingly checked by Garrard engineers, high fidelity's most experienced critics. Now this one turntable remains... the only one that met every critical test our engineers could devise. Someday this turntable will be ready for you... another development which lives up to the proud 40-year Garrard tradition of constantly striving to produce (and incorporate as quickly as possible) the meaningful advances in the world's finest record playing equipment.

Garrard
world's finest

range at a sensitivity of 20,000 ohms per volt. When interpreting voltages covered on this range, you must multiply the indication on the meter by 10. If a third range is desired—say 100 volts full-scale, add an additional 1.8 megohm resistor in series with the 200,000 ohms. All succeeding ranges are added in this manner.

Rather than actually connecting these multiplying resistors into the circuit individually as may be required, a switch can be used, with resistors to be used for the full multiplier circuit connected in series. The various taps are brought to the contacts of a switch, and the arm goes to the "hot" input terminal of the meter. The "cold" terminal is connected to the point where the meter movement is grounded—the side of the movement away from the multiplier.

The other attenuator in which you were interested is one whose input resistance remains constant regardless of the voltage being measured. Let us assume, now, that the sensitivity of this instrument is 2000 ohms for all voltage ranges. A 2000-ohm resistor is connected in series with the meter. The meter is padded so that one volt indicates full-scale. This is similar to what happens when we set up the 20,000-ohm-per-volt meter, but the similarity ends when other ranges are studied.

Now let us assume that we wish to measure two volts. The voltage source is connected across the meter and a 2000-ohm resistor. Since this voltage will be more than the full-scale indication of this instrument, additional resistance is placed in *shunt* with the meter movement. Some of the voltage will be diverted from the movement and will flow through the shunt resistor, and the meter will not be overloaded. Since the resistance of the meter is so much lower than the resistance of the multiplier, the change in resistance of the meter movement and its various shunts will have negligible effect upon the input resistance of the instrument. We can still say that, for all practical purposes, the resistance of the meter is constant for all voltages fed into it. Of course, these resistors are switched across the meter. All that is needed is a single-pole multiple-contact switch to do the job. The number of contacts which the switch must contain will depend upon the number of ranges the instrument is to have.

Notice that, in this last circuit, a *current* divider was used to extend the range of the instrument. In the previous circuit, a *voltage* divider was employed for this purpose.

Feedback Lamps

Q. Why do most audio frequency oscillators employ lamp bulbs in their circuitry? Arthur Darrow, Troy, New York.

A. An audio oscillator depends upon feedback to sustain oscillation. As is true of any circuit, feedback is subject to drift as tubes age or when the range over which the feedback is called upon to operate is fairly large. When the feedback changes, the audio oscillator no longer has a flat characteristic. Besides this, the distortion content of the oscillator varies. Trick circuits cannot stabilize the feedback and

(*Continued on page 60*)

MODEL 642
List $390.00

Here's what some of the top TV audio engineers told us this dramatic new microphone can do:

reach* two to six times the distance of cardioid types

reach with ambient noise and reverberation pickup reduced to one third that of cardioid types

reach to these distances with little or no loss of presence

reach that allows the use of wider-angle camera shots

reach that frequently eliminates the necessity of pre-recording

separation of vocalist and band, controlled to a degree never before possible

reduction of critical audio feedback problems

replaced parabolic microphones with excellent results

improved signal-to-noise ratio due to extremely high level output

*Microphone Working Distance

For the first time extreme directivity, wide range and highest output have been combined in one microphone. Unlike any other microphone available, the new E-V Model 642 allows new camera and sound techniques to improve production quality and lower production costs.

The 642 is so different we urge you to try it yourself in *your* studio. If you have problems with sound, this new working tool may well provide the answer. Your franchised E-V Broadcast distributor will soon be stocking this amazing new microphone. Why not arrange *TODAY* for your own test of the new Electro-Voice 642?

Write Dept. 60A, Buchanan, Michigan for complete literature.

better products for better sound

Electro-Voice®

ELECTRO-VOICE, INC., Buchanan, Michigan

LETTERS

Orchids to Us

SIR:

BRAVO for a fine editorial in May AUDIO.

The industry desperately needs some common sense and clear thinking like this.

Best regards.

CHARLES FOWLER
Great Barrington, Mass.

SIR:

I'd like to extend my compliments and thanks for the excellent editorial in your May issue.

Both the tape and disc markets have been panicked before by overenthusiastic and injudicious endorsements of new laboratory developments. Your sensible and helpful approach to this subject is very much appreciated.

I have taken the liberty of attaching the editorial to our Sales Newsletter. It will be a great help to the salesmen's morale and ability to maintain a stable market.

BILL MUSTER, Marketing Manager
United Stereo Tapes,
1024 Kifer Road,
Sunnyvale, California.

(*We are particularly grateful for these two letters from people in the industry, even though we blush slightly at presenting them. We do thank the writers, however, as well as the several others who have 'phoned with similar comments.* ED.)

Multiple Loudspeaker Systems

SIR:

My curiosity about the system described by Mahler in the December issue prompted me to try it out, but I was unable to find five 15-in. speakers after constructing the 32-speaker job described. Instead I set up a system consisting of eight good "brand-name" 12-in. full-range units, and placed the two systems in my basement about 25 feet apart. For a sound source I used both tape and records, with a Shure M3D for the latter, and played both through Citation I and II amplifiers. The twelve 8-in. speakers were mounted on an open baffle of ¾-in. plywood 3 × 8 feet in size.

The 12-in. array was connected in series parallel for a 16-ohm combination, as were the 32 five-in. units, and tweeters were added to both systems.

After many comparisons of output transformer hookups on both systems and with many types of music and voice, and at various volumes, I must agree with Mr. Mahler on what I have now, and as I hear it. Bass is not unnatural on the 32-unit system, whereas with the eight 12-in. units it has a deepness that I do not believe in. As for volume or air movement, I can hear very little difference, and as for over-all timbre and fidelity I will vouch for the 32.

It seems that speaker manufacturers could make a system comprising eight 12-in. units that would far surpass the 32 cheap 6-in. speakers. They might also do some work in 4- to 7-in. units for multi-speaker systems.

I believe that quick recovery and low effort on voice-coil movement is one way to good fidelity. Maybe if more people were to hear the multiple-speaker systems they would become much more popular than they are now, and possibly at a lower over-all cost.

JACK SHAFFNER,
P.O. Box 453,
Maysville, Missouri.

SIR:

I am most surprised that little or no reaction seems to have developed on one problem not covered in Mr. Mahler's article on small speakers. From memory, notes, and a quick search back through AUDIO, there is a fund of evidence that a multiple array of small speakers tends to concentrate high frequencies in a noticeable beam effect.

Not long ago I witnessed the results of a multiple array built by T. R. Gay of Encino, California. The beam effect was easily detected by walking back and forth and only a few inches of movement was needed to detect the beam boundary. Mr. Gay later developed a curved mounting baffle, which resulted in noticeable improvement but not elimination of the beam effect.

The over-all sound was quite good, but as sound is a subjective quality, I feel a distinct preference for a more conventional system and for an even dispersion of highs.

L. B. DALZELL,
1162 Fleetridge Drive.
San Diego, California.

Scott 299 Equipment Profile

SIR:

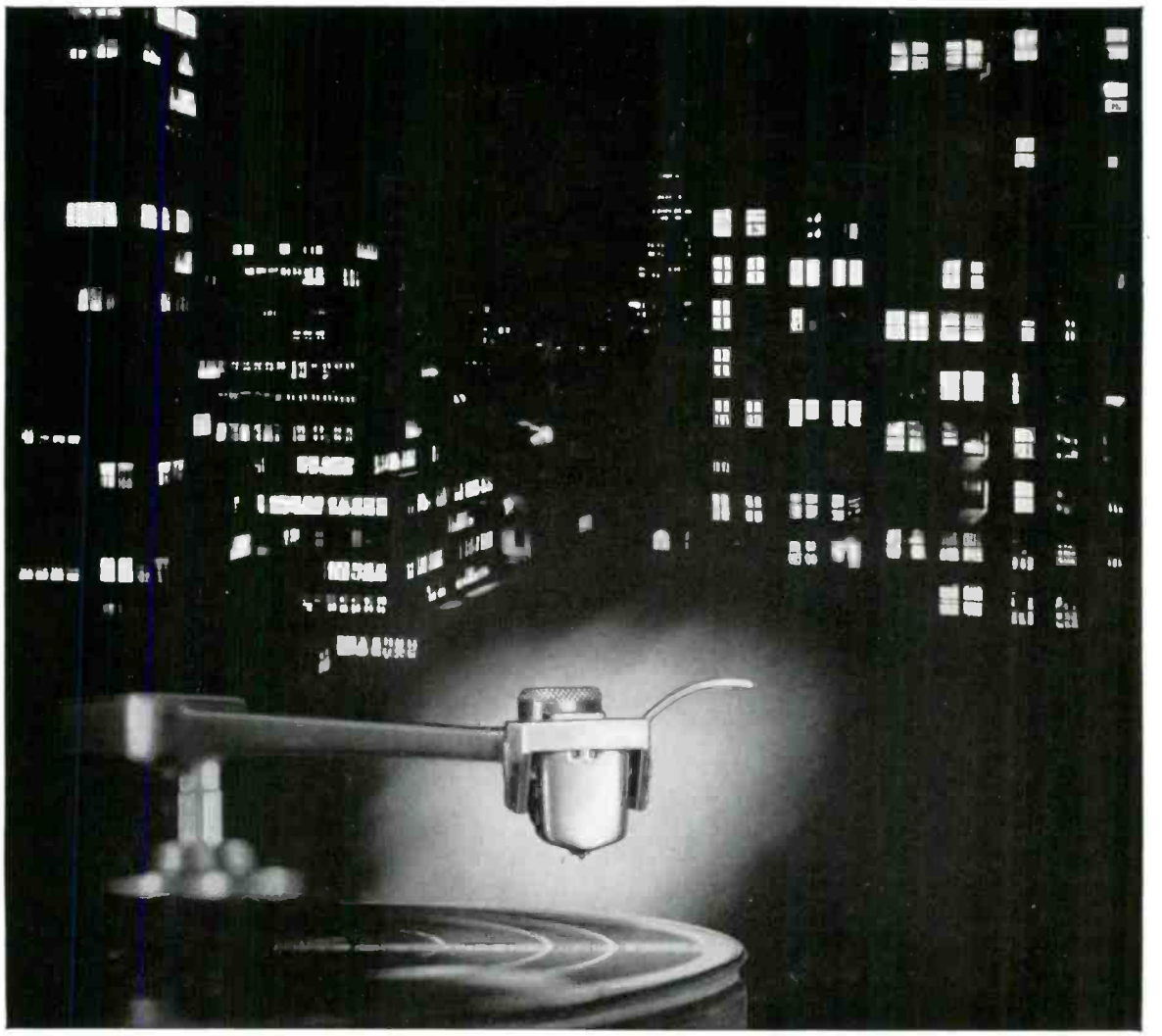
Let me congratulate you for a thorough job of testing and reporting on our 299 amplifier in the March issue. The test results which you were able to obtain parallel the results which we get with our test equipment within close limits. This speaks very well for the uniformity achieved by the IHFM Standard, the accuracy of the test equipment, and the ability of the observer to perform such measurements. All in all, the review is of professional caliber.

The review could have been perfect were it not for two small but important errors which could have been avoided if we had been given a chance to give comments before publication as to technical accuracy. These comments surely would have prevented these mistakes. (*The manufacturer never sees a Profile until it appears in the magazine.* ED.)

It was stated that "Factors tending toward a high MPO (music-power output) rating are a large storage capacitor . . . and a *low* value of series resistance between the rectifier tube and the supply tap." The italics are mine. This is not correct since an output stage operating under any conditions other than pure Class A shows an increase in current consumption when driven to full power output. This causes an increase in cathode-bias voltage and a decrease in plate (and screen) supply voltage with any other than a perfectly regulated supply. Since output stages are generally designed to operate at certain voltages and with a certain dissipation under no-signal conditions, an increase in effective power supply d.c. resistance would only decrease the maximum steady-state output power of the output stage. The music-power output would not be affected since the no-signal voltages are maintained for such a test and a power supply which maintains its output voltages is a perfectly regulated power supply. With such a supply, the steady-state power output and the music-power output will be identical (assuming that *all* supply voltages are regulated).

Power supplies used in amplifiers are not regulated and this is one of the reasons why the music-power output is higher than the steady-state output. Obviously, there is a practical upper limit of power-supply resistance. This limit is usually determined by the amount of distortion tolerable under steady-state and music-power operation, the amount of average and peak tube dissipation, and the amounts of the permissible tube currents. Cost and reliability of the supply also enters into consideration.

(*Continued on page 48*)



General Electric VR-22 Stereo Cartridge—Superior in the four vital areas

Stop to think for a moment of all the jobs required of a stereo cartridge: It must track, with utmost precision, in not one but two directions. It must separate the two stereo channels inscribed in a single record groove. It must perform smoothly in mid-range and at both ends of the audible frequency spectrum. And it must do all these things without producing noticeable hum or noise. Only a fantastically sensitive and precise instrument like the General Electric VR-22 can do all these jobs successfully.

General Electric's VR-22 is superior in the four vital areas of stereo cartridge performance: (1) **Compliance**—It tracks precisely, without the least trace of stiffness. (2) **Channel separation**—Up to 28 db for maximum stereo effect. (3) **Response**—Smooth and flat for superior sound from 20 to 20,000 cycles (VR-22-5), 20 to 17,000 cycles (VR-22-7). (4) **Freedom from hum**—The VR-22 is triple-shielded against stray currents.

VR-22-5 with .5 mil diamond stylus for professional quality tone arms, **$27.95***. VR-22-7 with .7 mil diamond stylus for professional arms and record changers, **$24.95***. Both are excellent for monophonic records, too. TM-2G Tone Arm—designed for use with General Electric stereo cartridges as an integrated pickup system, **$29.95***.

General Electric Co., Audio Products Section, Decatur, Illinois

*Manufacturer's suggested resale prices.

GENERAL ELECTRIC

CHESTER SANTON*

The symbol ✪ indicates the United Stereo Tapes 4-track 7½ ips tape number. When Mr. Santon has listened to the tape only, the tape number is listed first. Otherwise, the corresponding tape number is furnished by United Stereo Tapes.

STEREO

David Carroll: Let's Dance
Mercury ✪ STA 60001

Carroll's "Let's Dance' was a favored demonstration item wherever the audio trade had occasion to work with the early stereo discs. Visitors to the Murray Crosby Laboratories in the summer of 1958 heard the disc version of this recording as part of the multiplex test transmissions held there for all interested parties. The variety of not-always-expected percussion, evenly distributed throughout the breadth of two channels, was a natural for display purposes. Now processed by Ampex for playback on four-track tape, the recording sounds better than most of us had reason to suspect. It is only fair to add that an up-to-date remake of the stereo disc pressing also would bring us closer to the sound of the master tape. Dave Carroll's concept of dance music may have a bit too much tinsel for some tastes but you can't find a dull moment in the course of this reel.

Marty Paich: I Get a Boot Out Of You
Warner Bros. ✪ WST 1349

The perils of progressive swing! I started this reel as any well-intentioned reviewer would—at side one. Armed with the knowledge that Marty Paich had at one time studied the techniques of Stravinsky and Bartok, I listened to several items with mounting admiration for the man's coolness. Never had I heard an arranger handle Ellington and Porter material for a full band in so progressive a fashion. Here was a man determined to avoid the trite and the recognizable. Progress was on the march and I was going to be a party to it. Halfway through the first side mounting suspicion got the better of me. Winding forward and turning over the takeup reel, I immediately recognized the first tune as the one I had been listening for on the beginning of side one. The position of the tracks had been reversed on my review reel. While few will find the arrangements as progressive as I originally did, most cool-blooded swing fans will agree that Paich travels light yet really hugs the road in this one.

Ella Swings Lightly
Verve ✪ VSTC 222

So great is the fame of Verve's top vocalist they are able to present her on a solely first-name basis in her latest four-track reel. Nowhere on the box or label is there any inkling of the Fitzgerald name. The cover photograph and the supremely realistic sound take care of the matter. Fresh from her triumphs within the George Gershwin Songbook, Ella recharges a sizeable collection of old tunes few of us ever hear these days. These are completely chipper love songs. Listening to Ella having fun with *You're an Old Smoothie* or *Little White Lies* brings back a carefree era she helped to build during her dance band days. Her self-assurance could melt the reserve of a chap occupying one of five seats he had to purchase at a fireman's benefit. Marty Paich handles the orchestral accompaniments in brisk fashion. The sound is the best I've heard so far on a pop vocal tape. Scrupulously clean, it should deliver remarkably flat response on any peak-free rig.

Joe Reisman Solutes All-Time Instrumental Favorites
Roulette ✪ RTC 508

Tyree Glenn: Try A Little Tenderness
Roulette ✪ RTC 504

The Joe Reisman tape follows a logic of sorts in a medium that prides itself on its wearing qualities. However, is preoccupation with permanence going to affect the choice of repertory? The producers of discs have shown a willingness to record everything. A new artist, a fresh arrangement, a brand new or n forgotten piece of music. Tape, so far, has been playing it safe. This reel, for instance, offers the tape fan a dozen top-selling hits of the past few years in the most risk-free arrangements money can buy—those that made the tunes famous. Joe Reisman has duplicated with reasonable success the Winterhalter treatment of *Canadian Sunset*, Anderson's arrangement of *Blue Tango*, Mitch Miller's *Yellow Rose of Texas* and so on. Not for the adventuresome but undeniably reassuring to the person starting a collection of pop tapes.

The other Roulette reels stars character trombonist, Tyree Glenn, playing sweet stuff such as *It's the Talk of the Town* and *The Song is You* with a background of strings. If you like the sound of a talkative trombone, Glenn is your man. The miking accents every growl of a ripe style that could never be called reticent.

Olatunji: Drums of Passion
Columbia CS 8210

Drum fanciers are sure to spread from village to village the news that Columbia has a stereo recording of an authentic African drum troupe. Michael Olatunji came here from Nigeria as a student in 1950, later organizing a group of singers and drummers in order to recreate the songs and rhythms of the old and new Africa. In addition to a female chorus, he has three assistants helping him with the ten drums used in this album. The array of native instruments includes a log drum, a double-toned African gong, an African shaker, a bead-covered bone) and a sansa or African thumb piano. An astonishing variety of music is covered with these instruments—humorous work songs, drum duets, dance rhythms, and a chant to Shango, the God of Thunder—all in stereo deep enough to make this one of the more exciting releases in recent months. Because the ten drums are spread out in a line that stretches from speaker to speaker, a stereo pickup faces a challenge in separating the contrasting pulsations. Given a well-behaved arm and cartridge, this one is a dilly.

George Evans: The Greotest for Doncing, Vol. 2
London PS 169

If you think you've heard everything in the way of British handling of room acoustics, pull up a chair to this one. Try it at a level somewhat higher than one permitting normal conversation and you should hear chords soaring unimpeded to the higher rafters during this session of cha-chas, sambas, and waltzes. At each pause, the sound ends up somewhere in a second or third balcony. It's an effect I have not encountered in mono with a band miked at such close quarters. Quite a combination. Another novel touch is the gleaming backbone of about a dozen saxophones stretching the length of the orchestra.

Ashley Miller: The Fomous Radio City Music Hall Organ
Columbia CS 8230
Marjorie Meinert: Front Row Center
RCA Victor LSP 2170

Have you ever strolled into Radio City Music Hall when the spotlight was on the organ console and felt the pedal notes drift like a low mist through the vast auditorium? With the right equipment, you can experience such moments in Columbia's excellent stereo recording. This is easily the most sumptuous stereo available of the Wurlitzer located in the nation's showplace. Ashley Miller, a staff organist for seven years, has mastered the unique acoustical environment of the world's largest theatre and he displays this mastery in a tasteful program of pop standards and waltzes from Vienna.

Those seeking the lightest console touch among the new crop of organists are urged to investigate the latest album starring Marjorie Meinert. In her second release on the Victor label, this gal has the Lowry organ behaving like a trained gazelle in her rejuvenation of eighteen top songs of stage and screen. Miss Meinert allows herself considerable latitude in choice of tempos—not an unwise approach in territory of this familiarity.

Dietrich in Ria
Columbia WS 316

Until now the attire of the listener enjoying a normal recording of light music has been relatively unimportant. This, however, is not an average record. I started to listen to this Marlene Dietrich night club appearance in Rio de Janeiro while lounging at home in old duds. It didn't work out. The illusion of a huge and swank night club is too realistic in stereo. Mono or stereo, only a cad would show up in this audience in an unshaved condition.

Unlike the all-too-typical recording session where the orchestra and vocalist indulge in a short run-through before facing the control room, this is a beautifully polished act of the very highest standards. Burt Bachrach leads the orchestra that accompanies Marlene on tour. His arrangements, models of subtlety, are an instrumental extension of the unique inflection Dietrich brings to a wide variety of songs. The album cover photo explains the import of her opening tune *Look Me Over Closely*. Further human interest is found in the poised comments of the star as she introduces the German, French, and American songs on the first side of the record. Outstanding on side two are personalized treatments of *Makin Whoopee* and *One For My Baby*. The culminating touch of showmanship is a nostalgic and audience-hushing South American melody *Luar do Sertao*. On any continent, Dietrich is still a phenomenon of our time.

Greenwillow: Original Cast Album
RCA Victor LSO 2001

Greenwillow is a fable. In its planning stages, the stage version had much to buoy

(*Continued on page 61*)

* *12 Forest Ave., Hastings-on-Hudson, N.Y.*

NEW Stereo Master Audio Control Eliminates All Barriers To TOTAL FLEXIBILITY!

THE FISHER® 400-CX

10 Tubes • 27 Controls • 18 Inputs

A glance at the FISHER 400-CX is sufficient to evoke — even from the most sophisticated audio enthusiast — immediate and almost worshipful admiration. When you visit your dealer, however, do not merely look at the 400-CX — *operate it!* As you begin to experience the full potential of its beautiful control panel, see its channel indicator lights flash on and off as you switch from one mode of operation to another — you will make a most unusual discovery. You will realize that here is an instrument that has anticipated *your every wish.* Whether you are an audio enthusiast or audio engineer, you will discover that you will not be able to think of a single feature that the 400-CX does not *already* have. You will realize that here indeed is the *definitive*, the truly *complete* stereo control center! *15⅛" x 11½" x 4¹³⁄₁₆" high. Weight, 18 pounds.* **$199.50**

Walnut or Mahogany Cabinet, **$24.95** • Metal Cabinet, **$15.95**

SONIC NULL BALANCING Removes guesswork by eliminating the need to attain perfect channel balance based only on your ear's ability to determine optimum sound quality. With the 400-CX, you can balance the output of your components simply by tuning for *minimum* sound!

STEREO DIMENSION CONTROL Blends the signal from each channel into the other. Permits you to produce any degree of stereo separation (from zero to full,) eliminate extreme "ping-pong" effect and create the illusion that a third, 'in-the-center' speaker is in operation!

CENTER CHANNEL The 400-CX is equipped with a Center Channel output and a *front-panel Center Channel Volume Control.* Permits setting the level of the main speakers and third, center speaker, *independently,* thus providing maximum flexibility in multi-channel operation.

REMOTE CONTROL Add the low-cost FISHER RK-1 Control and achieve perfect stereo balance from your listening-chair! The RK-1 is only $17.95.

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AUDIO ETC.

Edward Tatnall Canby

1. CERAMIC STEREO

In between other activities of late, I've briefly tried out two stereo ceramics, just to keep my ear in, while the stereo magnetics continue to roll along. (Cartridges, I'm speaking about, of course. *Phono* cartridges, not tape.) I have no detailed performance comment to make on either of these models, not having done any measurements. But they have proved of significant interest, in view of the ceramic cartridge upswing, on which I commented at length a few years ago.

My two models were representative of late developments, the Electro-Voice Magneramic 31 and the Weathers StereoRamic C-501. (*When* will people get tired of this *rama* and *ramic* stuff? Must be a better suffix around, somewhere.) I'll say at once that both were good—excellent, if you wish—but that in neither case was I able to satisfy myself that I could listen to stereo on a good component system, with 100 per cent assurance of the best performance in the pickup department.

Interestingly, part of my doubts have to do with the inherent characteristics of this type of pickup. Mainly, I was never absolutely sure that the things were hooked up and matched in perfectly. It matters—whereas with magnetics it doesn't, relatively. That's the big point. This "matching" includes the tricky (for the amateurish pro) problem of hum, which is quite different in these devices from the more familiar hum of the magnetic arrangements.

I'll leave the technicalities to somebody else—who ought to write a series of articles on proper hookups for stereo ceramics. I only know that, paradoxically, the once-universal crystal cartridge is now for the majority of us a horse of an almost forgotten color, with idiosyncrasies that are no longer familiar. And, biggest paradox of all, the major old-time advantage of the ceramic cartridge, no preamplification, is now departed thanks to hi-fi economics and the semi-universal presence of preamps in amplifier equipment.

Only in the mass-production factory assembly of low-priced stereo machines is the ceramic still a basic asset in these terms. It can be, and is, designed into simple circuitry for such production and it has an enormous value there. But to acquire a ceramic for use with a magnetic-type preamplifier circuit, equalization and all, seems to me an economic redundancy. Like hooking a standard radio to a battery converter, then plugging that into the "mains" via a battery charger. Yet "magnetic" ceramics are being heavily pushed now, just the same. Both of these pickups are offered in this form, for connection to a magnetic preamp input. Goes to show that economics will produce strange markets, and perhaps legitimate under the special circumstances.

The Weathers (rumor says it is offered in lieu of a pending stereo development in the Weathers FM pickup department) is intended solely for this type of use and thereby invites direct competition among the magnetics. The E-V comes in alternative models, "straight" and for magnetic inputs. Covers the field.

Now I ask, what is the economic argument for these magnetic-input models? There are only three: (1) Quality, (2) convenience and (3) price.

There was a time when crystal cartridges were cheap. They still are, in the lower orders, But not these top-quality hi-fi models. In plain fact, the E-V cartridge costs within a dollar or so of leading comparable magnetics—and it isn't on the bottom, either. The Shure M7D, for one example, sells for exactly the same price, to the penny, in one catalogue I'm looking at: $23.52, as of last fall. That's low, for a stereo magnetic, high for any ceramic, at least in terms of a few years ago. No matter—they're the same in cost now, *and they feed into the same input.*

The Weathers ceramic seems to me to have the more pointed usefulness among component people, in view of its deliberately specialized intention, and its low price—only $17.50, again as of last fall. For performance, a six-dollar difference between this and a magnetic won't faze most buyers; but this one does have other features. It is extremely light in over-all weight, first. It will track at 2 grams. Hooked up rightly, it gives a sound pretty close to that of the fine magnetics. Nine out of ten experienced listeners would not be able to tell the difference—9.8 of most of us, caught off-guard. Potentially useful.

But, you see, you don't just plug these ceramics into your magnetic preamp. You can try, and with luck you'll be right the first time. I wasn't. My bungler's experience might be typical: my first Weathers hookup produced a gorgeous hum, as of an open ground circuit. Dickering by my assistant did something—I don't know what—to reduce it, but still there was some of that open-circuit sound, and there still is. My fault—most likely. But it's there. Then we found that an unduly shrill and bassshy sound, which I was sure was *not* the best of Weathers, might possibly be due to mismatching at the particular preamp. In went an extra resistor, 150k, straight across the signal lines. I gather my preamp-of-the-moment didn't look right to Weathers. This helped things immensely and, with these adjustments, I got a respectable hi-fi sound, at last.

But, you see, as an amateur hi-fi man I tend to quail at any cartridge that is choosy as to its inputs and may produce addled sound when it doesn't approve of a preamp. Give me, the unknowing dope, a reliable cartridge like a magnetic, that just plugs in. Oversimplified, this feeling, but it is clearly a factor of at least some importance in evaluating ceramics for hi-fi stereo. What's a bit of dickering with a resistor or two, inside the cartridge shell or even inside the preamp? Nothing, to most readers. Something quite unthinkable to many more, including me (as public representative of the breed).

The Electro-Voice Magneramic, the model that goes into magnetic inputs, costs more than the Weathers and is more conventional in outward design—deliberately. It is intended for direct, no-fuss replacement of magnetics.

Somebody at E-V is doing some shrewd calculating. Even the cartridge weight is adjusted a bit heavy, to allow direct replacement without extra arm weights—Weathers, oppositely, is tiny and ultralight, deliberately not for direct replacement.

This E-V seems to be slanted towards the inquiring amateur and the dopy serviceman. Even the instructions are neatly set up for minimum confusion, assuming a maximum of "just-plug-it-in" likelihood. I did, in fact, just plug it in, after mounting in a shell. And it worked. There's no dire warning in the accompanying literature of alternative or extra resistances, et al, except that, ominously, in the basic description it is "recommended" for loads of 22,000 to 47,000 ohms. Accentuate the positive! That implies, ever so discreetly, that there will be trouble in the case of other figures. However, a set of neat and decorative white-on-black diagrams provide alternative input circuits, cathode follower, feedback (flat), alteration of capacitance, etc., for knowing servicemen and amateurs.

In effect it all boils down to the same general situation as with the Weathers, merely put in more expertly persuasive terms. This is to the good, I'd say. Set your cartridge up for a calculated optimum likelihood of "as is" usefulness, write your literature accenting the same thing, and then put the alternative-situation stuff off to one side, decoratively, where it can be found when needed. E-V even covers such possibilities as a variable-resistance potentiometer that could change the high frequency response at different settings: replace with 3-meg load or higher.

Still further paralleling the current magnetic features, E-V makes its cartridges with both 0.5-mil and 0.7-mil tips, for "transcription arms" and for changers. Clear, unconfused policy. this, and it must be based on the probability, carefully assessed, that a lot of people will buy this not-so-cheap ceramic *after* some unfortunate experience with magnetic stereo. I don't get it, myself, but I recognize all the signs.

Sound quality? I think that ceramic stereo sound, to date, can be summed up fairly easily, once these peripheral annoyances of installation and proper circuitry are taken care of.

First, the two-element ceramics give as good separation as the comparable magnetics. (The cheap one-element ceramics do not, of course.)

Second, the frequency range is virtually as wide in the over-all, with possibly significant doubts arising in the extreme high and low department, for supercritical users.

(a) In the highs, much depends on the critically correct match-up, as per above. You may lose them all.

(b) In the lows, I find that for reasons unexplained to me there is a ceramic thinness, a weakness, that has so far been present in every trial as compared to magnetic stereo. It must, again, be inherent in the ceramic response, to various loads. I merely offer this as a practical working observation. Theoretically, it is avoidable, I suppose.

Third, specs are wonderfully high for these ceramics but, even so, I can't help

feeling that there is a slight residue of an old and familiar sound, a "crystal sound." Just a wee bit edgy most of the time, but especially in the loud passages.

I am aware that this last involves compliance, and the E-V is a flexible 3.5×10^{-6} cm/dyne, which ought to be plenty, in both directions, for top response. Again, the Shure M7D has the same compliance, exactly. (The fancier model Shure, M3D, goes higher and the Studio Dynetic Shure even further, as do other top-grade cartridges—but these are delicate mechanisms, for extremely careful use in high quality arms.) I suspect, then, that the ceramic trace of edginess is more subtle than the mere compliance of the stylus. It seems to me likely that, in slight degree, these sounds are still more or less inherent in even the best current ceramic design. Only a specialist could say just why.

I am fairly sure that their greater audible sensitivity, so to speak, to loading requirements, and their related sensitiveness in respect to equalization, make the ceramics of today distinctly more finicky than their magnetic peers.

It used to be the other way 'round. Just after the war, the magnetics, new and confusing in their reappearance, were the racehorse types, the finicky pickups that needed careful and special treatment—preamps, equalization, and all that. Crystals were simple, tried and true. Now, it's the new ceramics that are the thoroughbreds of temperament, the tricky numbers.

I guess I'm still a magnetic man.

* * * *

P. S. I clipped from a reputable metropolitan newspaper, some time back, the danglingest set of dangling comparatives yet—in a "Work Test" report on the Electro-Voice Magneramic 31, above. I quote.

"The problem of stereo, as you know, is to get exact translation of the three way stereo groove to the amplifier by means of the needle and its cartridge assembly. This No. 31 cartridge gave a noticeably smoother performance (*sic*), our speakers yielding cleaner tones (*sic*) with an absence of 'needle chatter'. We recommend it."

Well, so do I; but I'd like to know, pliz, about that smoother-cleaner business. Smoother than *what*? Cleaner than *what*? Doesn't say.

Maybe the printer just left out a couple of lines.

2. SHERWOOD S-4400, S-360

The editor has helpfully supplemented my forthcoming remarks ahead of time via his EQUIPMENT PROFILE on the Sherwood S-4400 36-watt stereo amplifier and I refer you to him (AUDIO, April, 1960) for a comprehensive detailed look. As always, I put these pieces of equipment to work, then see what happens—or doesn't happen—over the course of a good stretch of working operation. The EQUIPMENT PROFILE takes over where I leave off, test measurements not being my forte.

I got hold of an S-4400 myself, a good while back, to see how well this convenient type of stereo conversion equipment might work out in practice; it worked out so well that I've been using the Sherwood equipment ever since as one of my regular listening set-ups—while I busily write reams of this column on other subjects. It's about time I gave credit to Sherwood where it is clearly due.

I also took on a complementary Sherwood power amplifier, the single 36-watt S-360, which matches the built-in power amplifier in the S-4400; I've used it as an "optimum" added amplifier with the S-4400, as a check against the effectiveness

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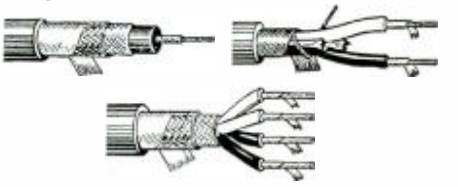

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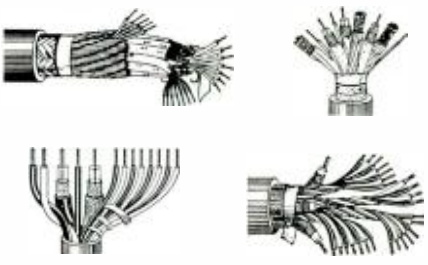

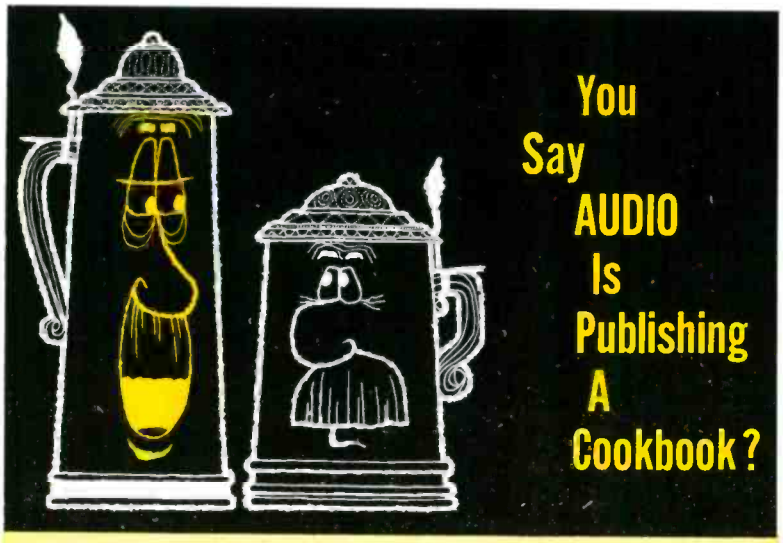

Yes, AUDIO is publishing a cookbook—not that we intend to extend the subject of gastronomy to include recipes in future pages of AUDIO.

You may ask...why?

And we would answer—Simply because we feel that people who read AUDIO, and enjoy the finest quality music reproduction also enjoy really good food on their tables.

Your next question may be...Is it a different kind of cookbook?

Of course our reply would be—Yes! Oh, it doesn't have a revolutionary format and it appears to look like any ordinary cookbook. But, the secret of its goodness is the recipes that fill its 148 pages... recipes responsible for the heart warming, flavorsome, homespun aromas experienced only in the kitchen of an Adirondack country home.

The name of the book is PLACID EATING, and it is chock full of palate-tempting recipes compiled by Climena M. Wikoff, owner of the Mirror Lake Inn ...at (you guessed it) Lake Placid, New York.

Actually, the first edition (now out of print) was discovered by Mr. AUDIO (C. G. McProud) during his stay at Mrs. Wikoff's Mirror Lake Inn, where, in Mr. McProud's own words—"*...every meal is so tasty that eating becomes a real joy, where each night's dessert excels the one from the night before, where one has to push himself away from the table before upsetting the daily calorie count.*"

Here is a cookbook that will enable you to recreate in your own homes superb dishes experienced only at the Mirror Lake Inn—dishes like *Lake Trout Baked In Wine* and *Adirondack Apple Pie*, recipes for which are reproduced below—

LAKE TROUT BAKED IN WHITE WINE

Remove heads and tails from a 2-pound fish. Split open down back and rinse well. Remove backbone and rub inside with lemon, salt, pepper and thyme to taste. Knead 1 tablespoon of butter and anchovy paste the size of a large pea; placing mixture inside fish. Place fish in a greased baking pan and cover with ½ cup of white wine. Bake 25 to 30 minutes in moderate oven, 350 degrees. Baste frequently. Garnish with parsley and lemon and serve with plain boiled potatoes.

ADIRONDACK APPLE PIE

1 c. sugar
2 tbsps. sifted flour
½ tsp. grated nutmeg
½ c. orange juice
⅓ c. melted butter
3 tbsps. white corn syrup
6 to 8 tart apples, thinly sliced
pastry

Mix together the sugar, flour, nutmeg, orange juice, corn syrup and melted butter. Add the sliced apples and mix thoroughly. Butter a pie pan heavily before putting in your pastry. Fill the pie shell with the apple mixture and make pastry strips for the top which should be dipped in melted butter before putting on the pie. Bake in 400 degree oven for 15 minutes; reduce heat to 250 degrees and bake 35 to 40 minutes longer.

This colorful book, plastic bound for easy handling, will contribute many wonderful adventures in food for everyone in the family. Order a copy today, the Lady-of-the-house will adore you for it. Incidentally...it makes a wonderful gift for anyone. PLACID EATING, 152 pages, Plastic Bound: $3.95.

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of other possible arrangements using various leftover power amplifiers from the good old mono days.

This last, of course, is the important point of interest. Can one safely use any old amplifier, for good stereo with this S-4400, thereby saving in the stereo conversion the cost of a second power amplifier?

After quite a bit of fussing around, I am quite ready to say yes. Well . . . *almost* any amplifier.

We all know, by this time, that stereo listening is a mess when two separate preamplifiers are used—especially when they are of unlike design. We are generally aware that the first essential in smooth component stereo is a sure-fire dual control system with the two preamps built together into one centralized system. Once you have this, you are relatively free in your choice of the power amplifier terminations. The Sherwood S-4400 represents one of various workable arrangemeuts for stereo conversion in which this principle is fully taken care of. Buy this unit and you have your preamps and centralized controls.

You have also one of your pair of power amps, built right in. You use your old power amplifier for the other, or even the final power section of an old mono "complete" amplifier, by-passing the original preamp. That way, you save at least a major part of your earlier investment. Decidedly worth consideration.

But how about matching up two unlike power amplifiers? What complications ensue? Practically none, in my experience to date. And, I think, for good reasons.

Remember that, compared to the complexities of preamps, the basic power amplifier is relatively simple. No equalization, no curves, no loudness contours, no fancy switchings—just straightforward amplification, flat. The variable factors, important enough in their place, are not in practice very noticeable. Compared to the instantly audible differences between a pair of unlike speakers of different brands, the sound from a pair of good but different power amps is generally uniform, the practical divergencies largely inaudible.

My first thought, then, was an obvious one—how about rated power? So I promptly hooked up a small, inexpensive power amplifier, rated around 14 watts, to work with the built-in 36-watt job inside the Sherwood. Grossly mismatched—both in power and in "price range." Experienced audio equipment users can guess what happened. The 14-watt job was louder than the 36-watter! Matter of effective sensitivity. After all, 36 watts is only a few db "louder" than 14 anyhow, and these figures are, as always, chosen in relation to distortion and the like, to give a measure of performance, rather than a literal indication of noise-making ability. I wasn't surprised.

Almost all power amplifiers now have level-sets at their inputs; a simple twist of the wrist brought my 36-watt and 14-watt amplifiers into balance—the rest was easy.

Admittedly, this was no ideal stereo set-up, nor was the sound 100 per cent right, coming from such different power amplification sources. But what pleased me was that, even so, the system was entirely *listenable* and useful. These differences that did become clear in the listening, such things as better transients, cleaner over-all sound, and especially, cleaner sound in loud passages, favored in the fancier amplifier of the Sherwood, did not make for musically unpleasant stereo—not by a long shot.

I hooked in the Sherwood S-360 in place

(*Continued on page 69*)

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EDITOR'S REVIEW

THE TAPE CONTROVERSY

FOLLOWING CLOSELY on the heels of our own comments about the proposed new low-speed tape playback system which was described thoroughly in our May issue, we are in receipt—second-handedly—of a communication from the head of Tandberg Radiofabrikk A/S, Mr. Vebjorn Tandberg, and we are more than pleased to reprint his letter in its entirety (page 67). We believe that he has brought out some points of interest from the technical standpoint that everyone in the tape industry should consider thoroughly.

One of the reasons for the success of the Tandberg products lies in the philosophy of the man himself. Single and with no heirs to whom he might leave the company, Mr. Tandberg formed a foundation which will continue the company after him, with practically all of the profits going to the employees. In the belief that satisfied workmen produce the best products, he has made the factory grounds into a park-like setting to provide a pleasant atmosphere in which to work; working areas are spacious, with no crowding, and employee activities are encouraged throughout the year. Vacations average around six weeks per year, and every opportunity is afforded for the comfort of the employee.

Since Mr. Tandberg is himself an engineer, his comments are important to the tape industry. And we know there are others who may have opinions on this subject and we will gladly publish any and all that are forthcoming.

SHURE EDUCATION PLAN

Working with four midwestern universities, Shure Brothers, Inc., has instituted a cooperative student training program to develop personnel for the acoustical sciences. Participating schools are Northwestern, Purdue, and Marquette Universities, and the Illinois Institute of Technology. According to S. N. Shure, president, students can begin the program in their sophomore year. Students alternate school study with practical laboratory and production work in the Shure plant at Evanston, Ill. While studying with the company, the co-op students are classified as employees, thus achieving seniority which they can use later if they go to work for Shure full time.

The industry needs more such plans. We have long felt that the IHFM ought to sponsor a chair of Audio Engineering in some suitable college or university—the subject is not a common one in any electronic curriculum we know of.

Of course, audio is a simple subject, covering only a range of some 20,000 cps. That just happens to be about ten octaves. Most electronic specialists in the ranges above UHF work over a range of a mere fraction of an octave, and techniques over the range are fairly constant. Even the audio novice knows that propagation of 20 cps into a room requires entirely different equipment than that for propagating 20,000.

STEREO RADIO TESTS TO BEGIN

The week of June 5 will mark the beginning of field testing of stereo radio broadcasting under the supervision of the National Stereophonic Radio Committee, established by the Electronic Industries Association. One test site has already been selected—KDKA, in Pittsburgh—and two others have been chosen tentatively—WCRB-FM and WBZ-FM, both in Boston.

Maybe we will have stereo broadcasts from a single station before long. It was almost two years ago when the first furore appeared and a number of multiplex adapters were introduced. The only stereo broadcasts now on the air are from simultaneous use of FM and AM stations, according to the EIA release, but WNCN and WRFM in New York team up with some excellent dual-FM stereocasts on Sunday afternoons. The new tests will cover FM only.

MICROMINIATURIZATION

The Components Conference held in Washington, D.C., during the week of May 9 brought out some interesting equipment possibilities in making electronic gear *much* smaller than it is now, with complete amplifier systems taking up no more volume than a child's toy block. Only problem we see is how to get ten knobs on a one-inch cube, along with indicator lights, output terminal strips, input jacks, and so on. Maybe we'll have to adjust volume, balance, tone, and so on with watchmakers' screwdrivers.

BRITISH EXHIBITION U.S.A.

We have just been exposed to a preview of one of the exhibits in the British Exhibition U.S.A. which is to hold the boards at the New York Coliseum from June 10 to 26, occupying all four floors. British products of all types will be shown, from the smallest consumer goods to the largest industrial items, and one entire floor is given over to automobiles. Our own British Industries Corporation is taking this opportunity to expose the estimated 400,000 attendance to the wonders of stereo and component high fidelity with an exhibit which will surpass that of any single exhibitor in the hi-fi shows.

Their manner of presenting the advantages of good music reproduction to everyone—not just the audiofan—is simply to reproduce music stereophonically as well as it is possible to do and at the same time to explain what each component does and why it is important to the over-all system. The explanation comes in the form of descriptive panels, in a style similar to science museums, with one typical people-type living room (contrasted to decorator-type) created by New York's Lord and Taylor as the setting for the equipment.

This should be studied carefully by all exhibitors as a model for other presentations. Not everyone is enthralled by a room containing twenty people constantly milling about while he is trying to form an impression of music as he would like to hear it in his own home.

Loudness does not necessarily ensure goodness.

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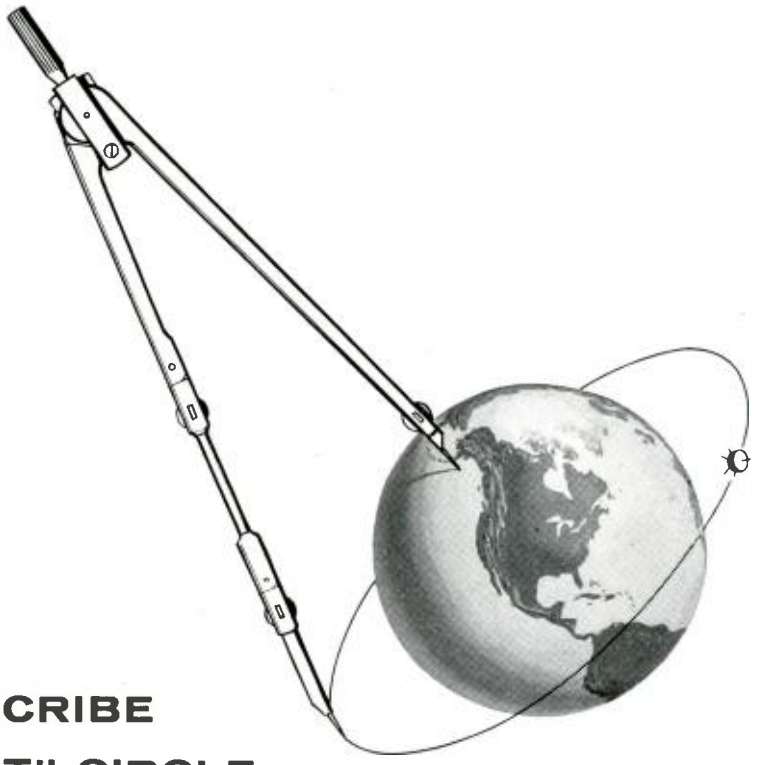

HOW TO SCRIBE A "PERFECT" CIRCLE IN OUTER SPACE

Bell Laboratories guidance system achieves unprecedented accuracy in steering Tiros weather satellite into orbit

Equipped with TV cameras, tape recorders, solar cells and antennas, the world's most advanced weather satellite, the NASA Tiros I, had to be placed in a precisely circular orbit at a specified altitude to do its job well.

The "shot" was a virtual bull's-eye. The mean altitude was within *one mile* of that planned. And the deviation from this mean was less than ½ per cent, making it the most-nearly-perfect circular orbit ever achieved with a space vehicle by either the United States or Russia.

Two Bell Laboratories engineers, T. J. Grieser and D. R. Hagner, look over the second-stage section of the Air Force Thor-Able missile used to launch the NASA Tiros weather satellite.

The dependability and accuracy of Bell Laboratories' ground-controlled Command Guidance System has been proven before—in the successful test flights of the Air Force Titan intercontinental ballistic missile, and in last year's Air Force Thor-Able re-entry test shots from which the first nose-cone recoveries were made at ICBM distance. Now, with Tiros, the system contributes to a dramatic *non*-military project. Other uses are in the offing.

This achievement in precise guidance again illustrates the versatility of Bell Laboratories' research and development capabilities—directed primarily toward improving your Bell Telephone service.

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W. B. BERNARD, Capt. USN

You can avoid both hum and the effect of long leads from cartridge to amplifier by building this simple preamplifier.

THE PLACEMENT OF the phono preamplifier at the turntable carries with it some very desirable advantages. The principal one being the elimination of long low-level cables which ordinarily connect the phono cartridge to the preamplifier at the control position. These long cables are a probable source of hum and they result in a capacitive load which may put a resonant hump in the response characteristic of the magnetic cartridge. When tubes were required in the preamplifier, the problem of supplying power to the preamplifier remotely located from the control unit had to be balanced against the undesirability of the long connecting cables. Objections resulting from the complications of supplying power to the preamplifier were practically eliminated by the advent of transistors.

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In the case of the preamplifier described here the a.c. input to the power supply is connected to the phono motor power leads so that anytime the motor is turned on, power is applied to the transistors. Further economies could be achieved by winding a secondary of about 6 volts on one of the legs of the motor stator which would permit the elimination of the power-supply transformer.

Circuit Description

Figure 1 is the schematic of one of the two identical preamplifier modules and the power supply unit used in the stereo system. Each preamplifier consists of three cascaded stages connected in the common-emitter mode. Each stage is stabilized by the use of resistors in the emitter circuit and d.c. feedback from the collector terminal to the base.

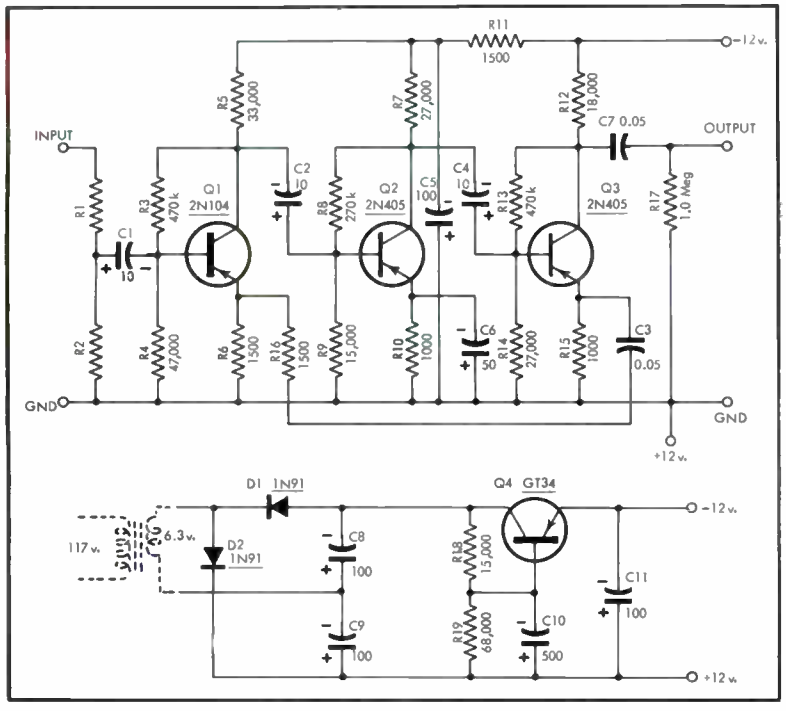

Fig. 1. Schematic of one preamp module and the power supply that furnishes power for two such modules.

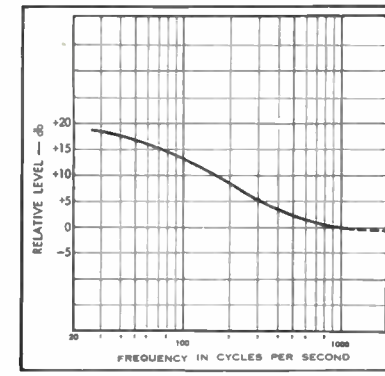

Fig. 2. Low frequency compensation for RIAA characteristic.

The first transistor, Q_1, is a 2N104 which is operated with the emitter resistor unbypassed. The current feedback developed in this resistor increases the input impedance of Q_1 to the point that the resistors of the bias network offer most of the loading to the phono cartridge. This is desirable since it permits us to know what the loading on the cartridge is, and this knowledge is essential if we wish to use resistance loading on the cartridge to achieve the high-frequency attenuation required to equalize the RIAA recording characteristic.

The second transistor, Q_2, is a 2N405. In this stage the emitter resistor is bypassed to secure the maximum signal gain. The third stage is also a 2N405. Like the first stage, the emitter resistor of the third stage is unbypassed. A feedback network from the emitter of the third transistor to the emitter of the first transistor is used to produce the low-frequency boost needed to compensate for the chararistics of the magnetic pickup cartridge.

The output impedance of the third stage is approximately 18,000 ohms, the resistance of the collector resistor of this stage. This impedance is low enough to allow a reasonable length of cable to be connected to the output of the unit if it is to be used as a voltage source, that is, used to feed a conventional tube-type amplifier. The impedance is high enough to consider the unit as a constant-current source if it is to be used to feed a

transistor amplifier. If it is to be used to feed a transistor amplifier the output capacitor, C_7, should be increased to at least 3 μf.

The high-frequency attenuation needed to compensate for the RIAA characteristic may be accomplished either by loading the cartridge or by loading the output of the preamplifier. Space is left on the module for the components needed to use either of these methods. However, loading of the cartridge is the more desirable since this method cuts down on the level of the signal which must be handled by the preamplifier, while the loading of the output offers the remote possibility that a very strong high-frequency signal might exceed the dynamic range of the output transistor. The necessary components for RIAA high-frequency compensation may also be connected in the cables external to the unit. This eliminates the problem of opening up the unit if it is desired to change the type of cartridge feeding it.

The unit described here has a mid-frequency gain of approximately 50 and an output capability of about 3 volts

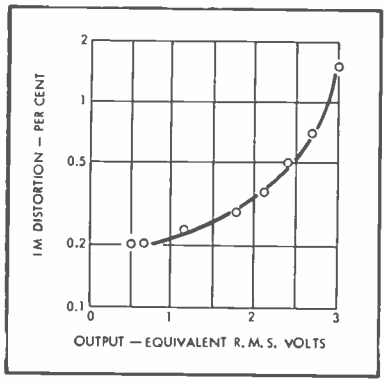

Fig. 3. Curve showing intermodulation distortion vs. output voltage.

r.m.s. when operated from a 12-volt d.c. power supply. The low-frequency response of the amplifier is shown in *Fig.* 2 and the distortion characteristic in *Fig.* 3. There is little change in the characteristics of the unit until a temperature of over 120° F. is reached at which time the dynamic range of the unit begins to decrease. By keeping the heat producing units of the stereo installation, such as the power output amplifiers, away from the phono turntable the temperature should stay well below the 120° point.

Output Capability

It should be appreciated that a transistor amplifier working with a 12-volt supply will have a much lower output voltage capability than will an electron tube amplifier operating from a 100- or 200-volt supply. If both units have about the same voltage gain the transistor unit will overload at a lower input

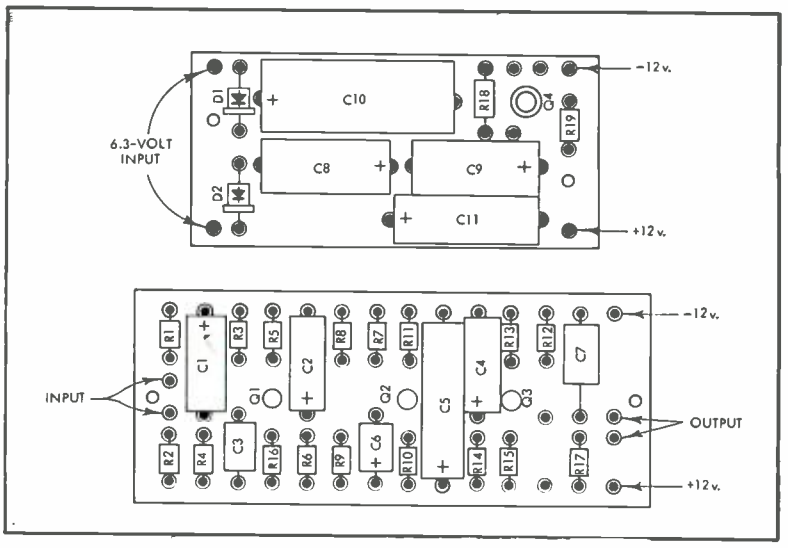

Fig. 4. Ports placement on preamplifier "chassis" (above) and power supply (below).

voltage than will the electron tube unit. With an output capability of 3 volts and a gain of 50 the unit described will accept an input of about 60 millivolts r.m.s. at 1000 cps and above without overloading. Such a capability is compatible with most of the magnetic cartridges available today. Should a cartridge having a nominal output of more than 25 or 30 millivolts be employed with this preamplifier it is recommended that the output voltage of the cartridge be reduced by a resistance network at the input of the preamplifier. The same resistance may, in many cases, be used to provide the high-frequency roll-off for RIAA compensation. The method of determining the values of the resistors needed is given in the appendix.

Because of the stabilizing effect of the feedback circuitry, the performance of the unit is not greatly affected by a change in the type of transistors used. A number of types have been plugged into the sockets for the last two stages with very little change in performance. 2N107's, 2N109's, 2N270's, and GT34's all seemed to work equally as well as the 2N405's shown in the diagram. Because of the low signal conditions under which the first transistor operates, the principal requirement placed on it is that it be a low-noise type. Although no other type was substituted for the 2N104 it is considered that any low noise PNP transistor would work satisfactorily in this position.

The power transformer is a 6.3-volt, 1-ampere filament transformer. This is considerably underloaded since the total current drawn by the two preamplifier modules is about 1 milliampere. However, the transformer is small and inexpensive so no great effort was expended

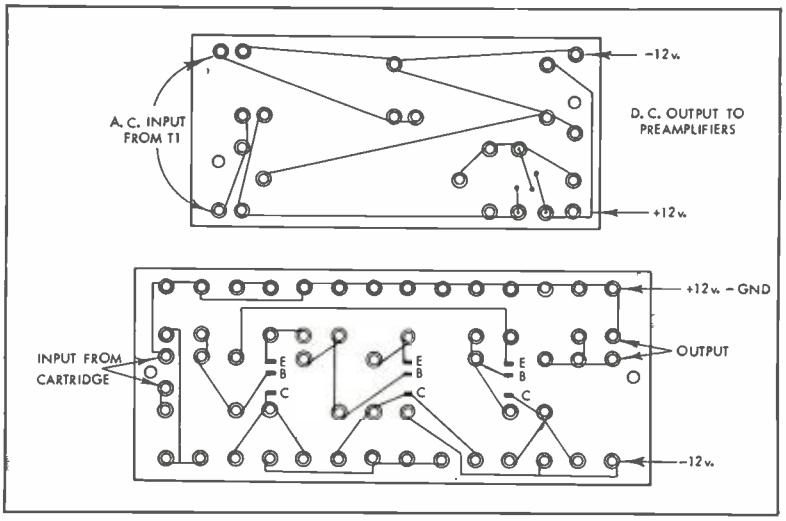

Fig. 5. Underside of preamp and power supply modules showing strapping between eyelets.

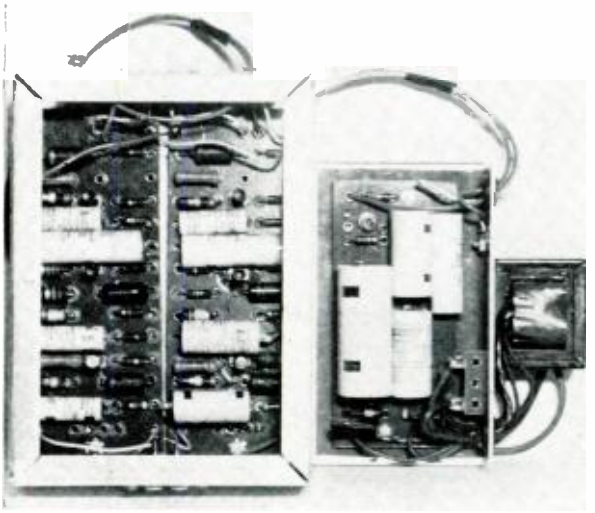

Fig. 6. Modules mounted inside enclosures.

to find a transformer which was theoretically better suited to the application. As stated previously, in many cases it should be possible to wind an additional winding on the phono motor to furnish current to the rectifiers. The 6.3 volts from the secondary of the transformer is run into a full-wave voltage doubler consisting of two 1N91 rectifiers and then through a GT-34 transistor which is used as a filter element. A transistor has one of the desirable characteristics as a filter choke—low d.c. resistance combined with a high impedance to a.c. In a capacitance-input filter system where the energy storage characteristic of a choke is not necessary, a transistor may be substituted for the choke with a considerable saving in space, weight, and cost. In such an application the designer must be careful not to exceed any of the limiting ratings of the transistor. In the power supply described here this did not operate as a restriction.

The output current from the emitter of the transistor will be just about as free of ripple as is the base-bias current so a fairly large capacitor is used in conjunction with the bias resistor network to ensure a smooth current supply to the base. The output of the supply is 12.5 volts with a ripple that is less than 1 millivolt.

Construction

Figure 4 shows the layout of the preamplifier and power supply modules. The module cards are constructed by drilling at the proper locations, inserting eyelets in the holes, and flaring the ends of the eyelets protruding from the bottom of the board. This flaring holds the eyelet in the card and permits #22 tinned bare wire to be wrapped around the flared portions of the eyelets to permit connections between the parts which have their leads passed through the eyelets from the top of the boards—a sort of "poor man's printed circuit." *Figure* 5 shows the connections on the bottom of the board. This construction method is much faster than the printed circuits where only a few units are desired. It has the same topological problems as a printed circuit and therefore can easily be converted to a printed circuit if a large quantity of the units is desired.

The two preamplifier modules are mounted inside a $5 \times 7 \times 2$ in. aluminum chassis. They are held away from the chassis by ½-in. spacers. The power supply module is mounted inside a $2\frac{1}{2} \times 2\frac{1}{2} \times 6$ in. Minibox with a thin sheet of phenolic material between the bottom of the card and the inside of the box. The power transformer is mounted outside the box to keep the heat from the transformer away from the other power-supply parts.

The chassis and the box, *Fig.* 7, are mounted under the motorboard of the turntable, taking care that the input jacks of the preamplifiers are near the pivot of the pickup arm and that the power transformer is as remote as possible from the position of the cartridge during operation. The primary leads of the power transformer are connected in parallel with the turntable motor leads, and cables are connected from the preamplifier outputs to high-level input jacks at the stereo control center. The system is now ready for operation.

With this system, hum problems are reduced to those produced by inductive pickup in the cartridge. Other noise is below the surface noise on your best record. You can now stop worrying about preamplifier problems and concentrate your worry on other things.

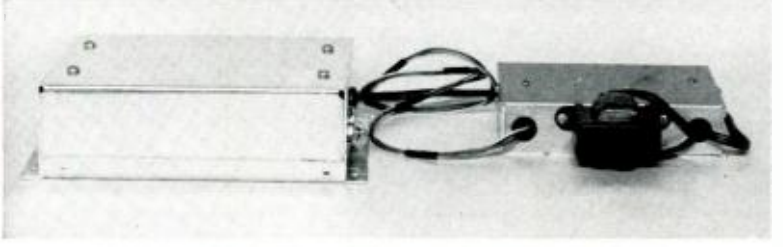

Fig. 7. Completed units ready for mounting under motor board.

Appendix

In considering the required load on the cartridge to give the RIAA high-frequency rolloff we must divide the cartridges into two general classes, those in which the output impedance is predominately inductive in nature, and those in which the output impedance is predominately resistive in nature.

Let us first consider those having an inductive characteristic. For these the resistive load on the cartridge should equal the reactance of the cartridge at 2100 cps.

$$X = 2\pi FL$$

so

$$R = X = 2 \times 3.1416 \times 2100 \times L$$

The answer comes out to be approximately

$$R = 13 \times L \quad (\text{L in millihenries})$$

Thus if the cartridge has an inductance of 350 millihenries we will need a load resistance of 13×350 or 4550 ohms.

Since the bias network amounts to about 40,000 ohms we must find out what resistance in parallel with 40,000 ohms will result in a total resistance of 4550 ohms. The value of a resistor R_x which when placed in parallel with R_b will give a parallel resistance of R_t is given by:

$$R_x = \frac{R_t \times R_b}{R_b - R_t}$$

In the case under discussion

$$R_x = \frac{4550 \times 40{,}000}{35{,}450} = 5100 \text{ ohms.}$$

The nearest standard resistor in the 10 per cent tolerance series is 4700 ohms which should give satisfactory results. A 5-per cent resistor may be purchased in the correct value but after soldering and aging take place you may not be any better off than if you had used the 10 per cent value. Referring to *Fig.* 1 we see that if the whole cartridge output is to be fed into the preamplifier the value of R_1 goes to zero and R_2 takes the value calculated for R_x.

Let us consider another case where we want to use a cartridge with an inductance of 500 millihenries and an output voltage high enough that we would desire to divide it by a factor of two.

$$R = 13 \times 500 = 6500 \text{ ohms}$$

To impress on the input of the preamplifier only one half of the output voltage of the

(*Continued on page 70*)

More on the Air Spring and the Ultra-Compact Loudspeaker

ROBERT C. AVEDON*

A thorough study of the effect of "stuffing" in a loudspeaker cabinet is presented with a view to determining the over-all effect on loudspeaker-enclosure performance.

In Two Parts — Part One

IN THE MARCH, 1959, issue an article[1] appeared in which the three authors presented their design for an ultra-compact, wide-range loudspeaker system. In addition to the theoretical treatment of that design, complete with supporting data, the authors attempted to dispel a number of popular misconceptions concerning the design and operation of such ultra-compact loudspeakers.

Subsequently, an article[2] appeared in the January, 1960, issue which takes exception to a number of the points that were presented in the previous article and brings up some additional matters which, too, are controversial. The particular issues are the non-linearity of the pneumatic spring vs. the mechanical spring, small air leaks in the sealed air cavity, ragged response due to standing waves in the air cavity, and the entire question of adiabatic *vs.* isothermal pressure changes and the effect on these ultra-compact loudspeakers.

In the best interest of the science of electroacoustics, particularly loudspeakers, one of the authors of that original article, the present writer, treats again in greater detail those points which are now in question. In this part of the presentation the writer will examine exhaustively only those issues which are directly related to the air spring as it is applied to loudspeakers. The forthcoming Part Two of this article will deal separately with the mechanical suspension. To the reader, the conclusions to be drawn from theory and experiment will be incontrovertible.

In his article, Mr. Villchur makes no mention of, and, therefore, apparently has no objection to the theoretical and experimental proof of the actual operation of the ultra-compact loudspeaker as presented in the original article wherein it was thoroughly proven that even the complete elimination of the mechanical suspension on a conventional 12-in. loudspeaker is insufficient to provide satisfactory low-frequency response. It was shown that the designer had but one other recourse in obtaining sufficiently low system resonance—to utilize a heavier, more massive moving system or to add mass to the conventional moving system. It was proven, too, that this high moving mass is the factor almost totally responsible for the lower efficiency of these ultra-compact systems by comparison to larger direct-radiator systems having the same system resonance.

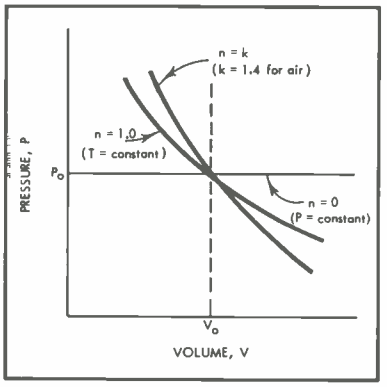

Fig. 1. Special cases of the polytropic process.

The writer wishes to reiterate that these ultra-compact systems *are not* indebted for their low-frequency performance to a reduced cabinet volume which compensates for stiffness removed from the driver suspension. The cabinet size was chosen to meet popular demand, as much stiffness as possible was removed from the driver suspension, and the moving assembly was deliberately made sufficiently massive to place the primary system resonance at an acceptable frequency.

If greater cabinet volume were allowed (as in more conventional direct-radiator systems) similar frequency response would be maintained with the same high-compliance driver by removal of mass from its moving system. With the larger cabinet must come, then, reduced transient distortion and substantial increase in efficiency resulting in reduced amplifier power requirements and increased dynamic range. At this writing no further discussion will be given to these last mentioned points.

Thermodynamic Characteristics of a Gas

Since one of the prime purposes of this paper is to investigate in considerable depth the nature of the air spring, a brief review of the thermodynamics of gas compression and rarefaction will give the reader a better insight into the properties of the air spring.

There is an infinite number of processes by which a gas can be changed from one state to another. The state of a gas is described by its temperature, pressure, and volume. The process by which a gas is made to change its state will determine the values of these properties at the new state.

The change of state which follows the equation

$$P V^n = C \qquad (1)$$

is called the polytropic process wherein

P is the gas pressure
V is the gas volume
C is a constant determined from the initial conditions of P and V
n is any real number

Figure 1 shows graphically a number of processes for some values of the exponent n. When a property of the gas (pressure, temperature, or volume) is held constant while the others are allowed to change, or a certain special condition is imposed, the process is given

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[1] Robert C. Avedon, Wayne Kooy, and Jack E. Burchfield, "Design of the wide-range ultra-compact Regal speaker system," AUDIO, March, 1959, pg. 22.

[2] Edgar M. Villchur, "Another look at acoustic suspension," AUDIO, January, 1960, pg. 24.

a new name indicative of the special case. Referring to Eq. (*1*), it is seen that when $n = 0$ the pressure is held constant, this process being called isobaric (one pressure). When $n = 1.0$ the temperature is held constant and the process is denoted isothermal (one temperature). For air, if $n = 1.4$ the process is called adiabatic.[3] Thermodynamically, when adiabatic compression or rarefaction occurs, at no time does heat energy pass through the interface between the gas and its container or any bodies immersed in the gas within the container.

The two processes which are significant in loudspeaker engineering are the adiabatic and isothermal. It is of interest to note that the everyday sound that we hear is essentially of adiabatic character. As each minute volume of the air around us is rapidly compressed and rarefied with the passage of even low-frequency sound propagation, there is insufficient time for transfer of much heat of compression to and from the neighboring air or any surfaces with which the air may be in contact. To cause sound wave propagation to become isothermal a means must be devised whereby heat is extracted from the air at each pressure crest and added at each rarefaction trough. Sound wave propagation velocities computed on the basis of the adiabatic process agree quite closely with measured values.

The derivation for the mechanical spring rate or, inversely, mechanical compliance of a closed volume of air behind a rigid piston is readily available.

From Eq. (*1*) it can be said that

$$P V^n = P_o V_o^n \qquad (2)$$

where

P_o is the quiescent pressure
V_o is the quiescent volume

Referring to *Fig.* 2, it is seen that an infinitesimal piston displacement, dx, will cause a corresponding infinitesimal volume change, dV, and pressure change, dP (unless $n = 0$) from the quiescent conditions of x_o, V_o, P_o. Differentiation of Eq. (*2*) yields, then,

$$\frac{dP}{dx} = -n P_o V_o^n V^{-(n+1)} \frac{dV}{dx} \qquad (3)$$

The volume of the gas at any x is

$$V = (V_o - A x) \qquad (4)$$

where

A is the piston area

and differentiating Eq. (*4*) with respect to x yields

$$\frac{dV}{dx} = -A \qquad (5)$$

[3] For general application to any gas $n = k$ for the adiabatic process. $n = Cp/Cv$, the ratio of the two specific heat capacities for a gas. This ratio is 1.4 for air.

By the definition that the stiffness, k_s, is the force per unit displacement, then

$$k_s = A \frac{dP}{dx} = \frac{n P_o A^2}{V_o} \left[1 - \frac{A x}{V_o} \right]^{-(n+1)} \qquad (6)$$

The bracketed quantity in Eq. (*6*) indicates that the stiffness of the air spring is dependent on the piston displacement x and, hence, is non-linear. It matters not whether the n in the exponent is 1.4 (adiabatic case for air) or 1.0 (isothermal case), the bracketed quantity still remains and the air spring is, therefore, still non-linear. It is interesting to note that the greater is V_o, the quiescent volume, the closer the bracketed quantity approaches unity and, hence, the more linear the air spring becomes, all other factors remaining constant.

For minute displacements and/or large quiescent volumes, Eq. (*6*) can be simplified to

$$k_s = \frac{n P_o A^2}{V_o} \qquad (7)$$

This equation accurately describes the stiffness for infinitesimal deflections in the neighborhood of the quiescent point. Equation (*7*) can be rearranged to better fit loudspeaker terminology as

$$C_{MA} = \frac{1}{k_s} = \frac{V_o}{n P_o A^2} \qquad (8)$$

where

C_{MA} is the *mechanical compliance* of the air spring with the dimensions of displacement per unit force

If desired, the *acoustic compliance* of the air spring can be obtained by dropping the A^2 in Eq. (*8*) to give

$$C_A = \frac{V_o}{n P_o} \qquad (9)$$

where

C_A is the acoustic compliance of the air spring with dimensions of volume displacement per unit pressure.

Equations (*8*) and (*9*) are both found in most books on acoustics and electro-acoustics, and Eq. (*8*) is also found in books on mechanics. A reference [4] points out clearly that Eq. (*8*)—and, therefore, Eq. (*9*) as well—is an approximation and that the air spring stiffness is *inherently* non-linear because of its dependence on displacement, *not* because it is adiabatic rather than isothermal. With finite volumes and displacements the *only* way Eq. (*6*) could become inherently linear would be to devise a means of making $n = -1$, causing the non-linear bracketed factor to become constant at unity regardless of displacement. However, this would also cause the spring to exhibit negative stiffness! As a former student of thermodynamics, the writer has never seen this done nor does he have the vaguest idea how to accomplish this by purely passive means (i.e., without resorting to a system of pumps, perhaps). Incidentally, if n could be zero the cavity would exhibit no stiffness! Unfortunately, the only possibility open to loudspeaker engineering, where the only external influence on the air spring is force applied to the piston, is $1.0 \leqq n \leqq 1.4$, namely the isothermal, the adiabatic or any condition in between. If the spring is adiabatically operated it has the least compliance for a given V_o. If the spring can be isothermally operated the compliance will become 1.4 times higher than that of adiabatic operation for the same V_o.

With this résumé of the basic thermodynamic principles underlying the compression and rarefaction of a gas, attention is now directed to a discussion of the air spring.

Non-Linearity of the Air Spring

Mr. Villchur's argument on the linearity of the air spring is as follows:

> ". . . When the speaker cone moves back half an inch and decreases the air volume to 0.9925 of its former value, the air pressure would, in the perfectly linear case, increase by a factor of 1.00755. Instead, in the non-linear case, it increases by a factor of (1.00755) or 1.01. Raising the former number to the 1.04 power hardly changes it. The non-linear aberration involved—the difference between 1.00755 and 1.01—is of the order of one-fourth of one per cent, a totally insignificant figure in the field of loudspeakers."

Regarding fiberglass stuffing in the sealed air cavity it is stated:

> "The isothermal behavior of air in a cavity filled with the proper absorbent material has been known for years, and is described in the literature.
> "Thus even the tiny amount of distortion associated with air non-linearity is not present in an acoustic suspension system designed according to the writer's patent. It is true that the primary purpose of the fiberglass is not to eliminate distortion due to air non-linearity . . . but it is interesting to note that even this small amount of distortion does not remain."

In his exploration of numbers and commentary on the isothermal behavior of air in a cavity filled with absorbent material, Mr. Villchur seems to indicate that distortion occurs only when the n exponent in Eq. (*1*) is other than unity, particularly *1.4* for the example described. In the perfectly linear case he describes, the pressure and volume changes stated fit Eq. (*1*) perfectly for $n = 1.0$ and the writer must logically assume, then, that Eq. (*1*) with $n = 1.0$ was the basis for perfect linearity. Without even going to the proof of Eq. (*6*) the writer's knowledge of basic analytic

[4] W. T. Thomson, *"Mechanical Vibrations,"* pg. 81, Prentice-Hall, Inc., 1953.

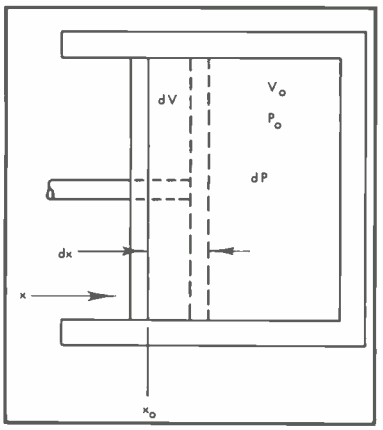

Fig. 2. Rigid piston in a sealed gas-filled cavity.

geometry leads him to see immediately that this "perfect" case is, indeed, nonlinear because the equation takes the general form of

$$x\,y = c \text{ [a Constant]}$$

an equation which describes an hyperbola. The reader is asked to refer to *Fig.* 1. to observe the hyperbolic curvature for the case where $n = 1.0$.

To corroborate this, distortion analyses were made on the force *vs.* displacement characteristic in accordance with Eq. *(1)* for a 10-in. piston excurting ½ in. in a 1.5 ft³ air cavity. The analyses covered the cases for $n = 1.0$ (isothermal) and $n = 1.4$ (adiabatic). Since an equation is readily available for the air spring, a Taylor expansion proves simpler for analysis than the Fourier method although both will give identical results.

The distortions computed from this analysis are 0.37 per cent for the isothermal case and 0.42 per cent for the adiabatic case.

Rearranging Eq. *(1)* for V as the dependent variable obtains

$$V = \left[\frac{C}{P}\right]^{1/n} \qquad (a)$$

For a sinusoidal variation in P it can be said that

$$P = P_o + p_o(\cos \omega t) \qquad (b)$$

where

P_o is the quiescent pressure
p_o is the peak pressure of the sinusoidal component

Substitution of *(b)* in *(a)* yields

$$V = \left[\frac{C}{P_o + p_o(\cos \omega t)}\right]^{1/n} \qquad (c)$$

For ease, define

$$S = 1/n$$
$$c = C^{1/n} = C^s$$

Then, from *(c)*

$$V = \frac{C}{[P_o + p_o(\cos \omega t)]^s}$$

or

$$V = c[P_o + p_o(\cos \omega t)]^{-s} \qquad (d)$$

From *"Mathematical Tables From the Handbook of Chemistry and Physics,"* 10 h edition, pg. 296, is obtained the Taylor's expansion:

$$f(x+h) = f(h) + xf'(h) + \frac{x^2}{2!}f''(h) + \frac{x^3}{3!}f'''(h) + \ldots \qquad (e)$$

where the limitation is that x be a small variation about h.

Identify

$$V = f(x+h)$$
$$h = P_o$$
$$x = p_o(\cos \omega t)$$

Then

$$f'(x+h) = -cs[P_o + p_o(\cos\omega t]^{-s-1}$$
$$f''(x+h) = cs(s+1)[P_o + p_o(\cos \omega t)]^{-s-2}$$
$$f'''(x+h) = -cs(s+1)(s+2)[P_o + p_o(\cos \omega t]^{-s-3}$$

Evaluating at h yields

$$f(h) = cP_o^{-s}$$
$$f'(h) = -csP_o^{-s-1}$$
$$f''(h) = cs(s+1)P_o^{-s-2}$$
$$f'''(h) = -cs(s+1)(s+2)P_o^{-s-3}$$

Substitution into Equation *(e)* obtains

$$V = cP_o^{-s}\left\{1 - s\left[\frac{p_o}{P_o}\right]\cos \omega t + \frac{s(s+1)}{2}\left[\frac{p_o}{P_o}\right]^2 \cos^2 \omega t \frac{-s(s+1)(s+2)}{2.3}\left[\frac{p_o}{P_o}\right]^3 \cos^3 \omega t + \ldots\right\} \qquad (f)$$

Substitution into Eq. *(f)* of the trigonometric identities:

$$\cos^2\omega t = \frac{1}{2} + \frac{1}{2}\cos 2\omega t$$

and

$$\cos^3\omega t = \frac{1}{4}\cos 3\omega t + \frac{3}{4}\cos \omega t$$

yields

$$V = kP_o^{-s}\left\{\left[1 + \frac{s(s+1)}{4}\left(\frac{p_o}{P_o}\right)^2\right] - s\left(\frac{p_o}{P_o}\right)\left[1 + \frac{s+1\ (s+2)}{8}\left(\frac{p_o}{P_o}\right)^2\right]\cos \omega t + \frac{s(s+1)}{4}\left(\frac{p_o}{P_o}\right)^2\right] \cos 2\omega t$$

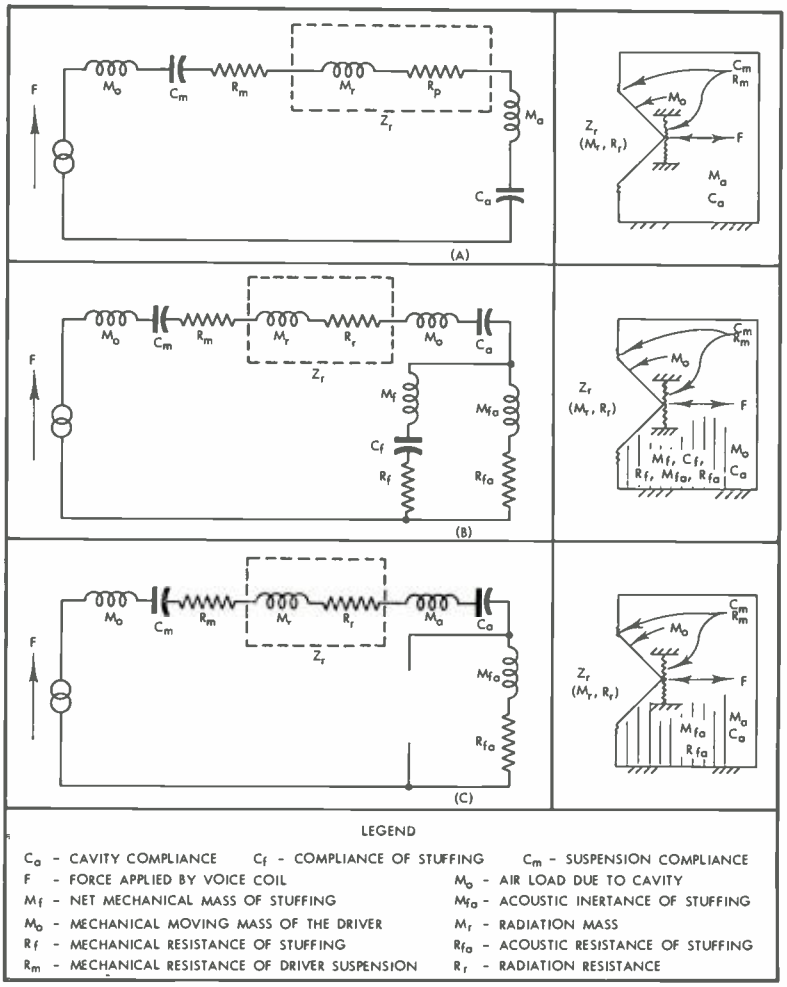

Fig. 3. Equivalent circuits: (A) unstuffed cavity, (B) stuffing placed in cavity loosely, and (C) stuffing placed in holding frame in cavity.

$$-\frac{s(s+1)(s+2)}{24}\left(\frac{p_o}{P_o}\right)^3\cos 3\omega t+\ldots\Bigg\} \quad (g)$$

The amplitude ratio of second harmonic to fundamental as found from Eq. (*g*) is

$$\frac{A_2}{A_1}=\frac{s(s+1)}{4}\left(\frac{p_o}{P_o}\right)^2$$
$$s\left(\frac{p_o}{P_o}\right)\left[1+\frac{(s+1)(s+2)}{8}\left(\frac{p_o}{P_o}\right)^2\right]$$

which may be approximated as

$$\frac{A_2}{A_1}=\frac{s+1}{4}\left(\frac{p_o}{P_o}\right)$$

or

$$\frac{A_2}{A_1}=\frac{\frac{1}{n}+1}{4}\left(\frac{p_o}{P_o}\right)$$

The amplitude ratio of the third harmonic to the fundamental is similarly found. Only the second and third harmonics were used since the fourth reduced to insignificance. The total distortion (given as a per cent of the fundamental) is

$$D\sqsubseteq\sqrt{\left(\frac{A_2}{A_1}\right)^2+\left(\frac{A_3}{A_1}\right)^2}\,(100)$$

and for the two cases studied:

$$D_{(isothermal)}=0.37 \text{ per cent}$$

$$D_{(adiabatic)}=0.42 \text{ per cent}$$

It is fully proven in the foregoing, then, that the isothermal cavity exhibits distortion, though less, of the same order of magnitude as the adiabatic cavity.

The Adiabatic and Isothermal Processes

A series of experiments was carried out to determine the degree to which the air spring behind the driver cone can be made isothermal. Before discussing this investigation a rationale of the impedance type equivalent circuits of *Fig.* 3 must be made. All discussion and experimental results will be presented in mechanical terminology; that is, all impedances, potentials, and currents will be reflected into the mechanical network and characterized by forces, lineal displacements and velocities.

In *Fig.* 3, (A) shows the well known series representation of a closed-box direct-radiator loudspeaker system with nothing but air in the cavity. The radiation air load (on the front of the piston) is shown as a mass in series with a resistance.

An element not too often included in the impedance of the air cavity is M_a, the air load mass on the rear of the piston. This element appears in series with the cavity compliance, C_a, and is well behaved where C_a itself is well behaved, namely where the wavelengths are equal to or greater than about eight times the nominal box dimension. With the box dimensions and frequency range used in the experiments, the wavelengths were approximately 22 to 50 times the box dimensions, making the cavity well behaved, indeed. Since the impedance analogy as shown for the case of (A) in *Fig.* 3 is well accepted no further discussion of it is necessary.

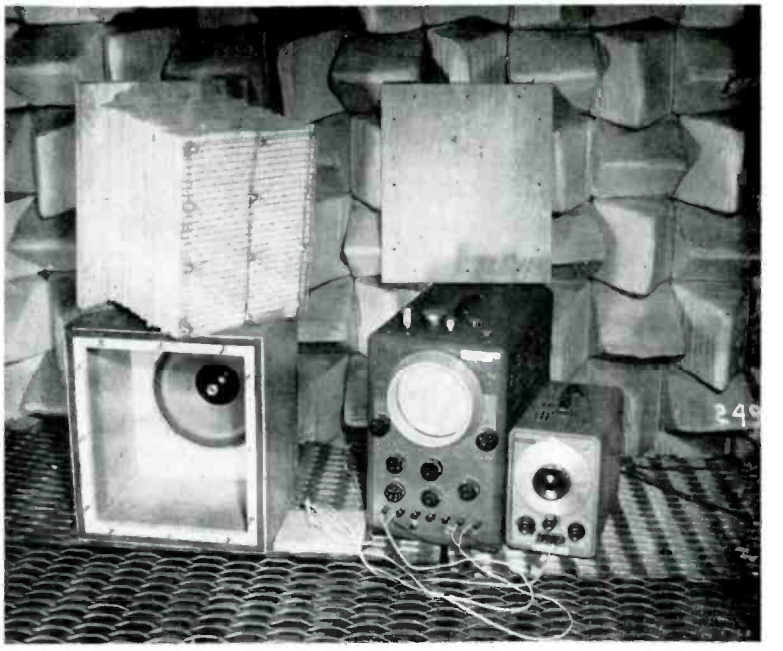

Fig. 4. Experimental apparatus showing inside of enclosure, placement of an additional mass, and the framework for holding the fiberglass stuffing.

The equivalent circuit representation of the much more complicated case wherein fiberglass stuffing is used to fill the cavity is shown at (B) in *Fig.* 3. This case is not quite so simple as it might seem at first glance.

Generally speaking, with the fiberglass stuffing placed loose in the cavity there is no reason whatever to think that it remains immovable when signal is impressed on the piston. As the air in the cavity is compressed and rarefied the molecules of air closest to the cone move with the largest amplitude while those right at the enclosure walls do not move at all. Certainly as air moves through the interstices of the fibrous stuffing it will encounter a resistive component of force. The fiberglass bulk is compliant and not very massive and it, therefore, must move to some degree with the air motion. Additionally, the air velocity

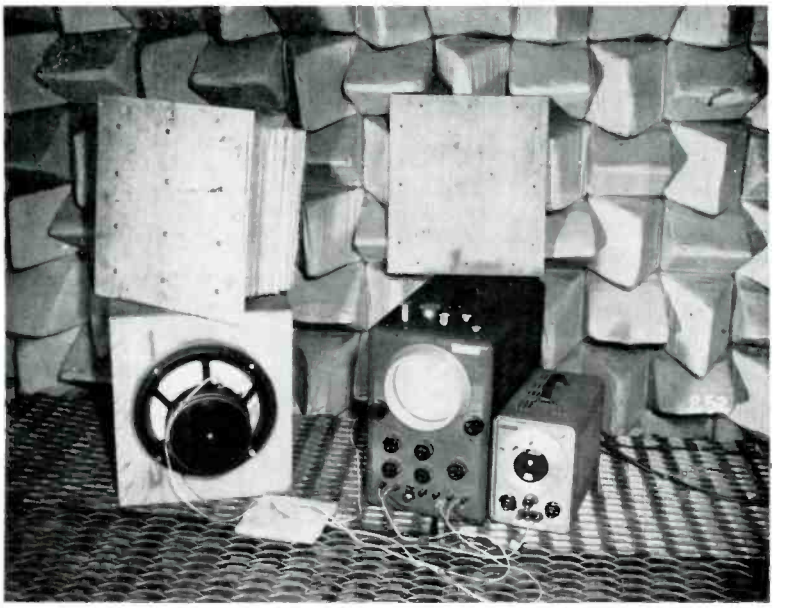

Fig. 5. Experimental apparatus showing outboard mounting of driver. This mounting facilitated construction of the fiberglass holding framework and avoided complicated internal volume computation. Of course, it makes no difference in the value of n whether the driver is mounted inboard or outboard.

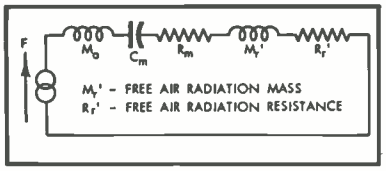

Fig. 6. Equivalent circuit of speaker mechanism in free air.

will contend with a certain inertance due to its motion through the interstices of the fiberglass. Acoustic resistance is always accompanied by inertance and vice-versa.

Those impedances related to the fiberglass shown at (B) are to be taken as driving point impedances (and in mechanical dimensions), namely, as they are seen by the driver. These are distributed parameters and are seen as net lumped effects on the driver voice-coil motion (and, of course, cone motion).

There are five distinct impedances describing the fiberglass as indicated at (B). M_f is the net moving mass of the material, C_f is the net mechanical compliance due to the bending of one fiber against another and R_f is the net mechanical resistance due to internal damping within each fiber as it bends and due also to the grating and rubbing of one fiber on the next. These three elements are in series with each other. M_{fa} is the net mechanical mass due to the *acoustic* inertance of the stuffing as seen at the driver and R_{fa} is the net mechanical resistance due to the *acoustic* resistance of the stuffing. These two elements are in series with each other and parallel the M_f-C_f-R_f branch.

Is this configuration correct? A number of examples wherein the relative impedances of these five elements are varied follows:

1. Suppose the stuffing could be made extremely stiff (C_f very small). It would not bend or move in a compliant manner. If this very rigid bulk were in contact with the enclosure walls it could not move as a unit either. Of course, there could not then be a velocity through M_f or R_f. Suppose the stuffing could be made extremely massive, but still compliant and resistive. The individual fibers (and the bulk as well) would be so heavy that they would be essentially immobile. There could not, then, be a velocity of any consequence through C_f and R_f. A similar argument holds for an extremely high R_f. The three elements M_f, R_f, and C_f are obviously in series.

2. Suppose that the acoustic resistance of the stuffing were made so large that no air motion could exist *through* the interstices of the material. There could then be no velocity through the acoustic inertance. Likewise, if the acoustic inertance were made so large that no air velocity could exist within the material, no velocity would exist through the acoustic resistance. Hence, R_{fa} and M_{fa} must be in series.

3. Suppose that M_f and/or R_f were made extremely large and/or C_f very small so that the fiberglass would be essentially immobile. If air could still "blow" through the interstices of the stuffing, then the M_f-C_f-R_f branch would be substantially open circuited in comparison to the M_{fa}-R_{fa} branch and all the velocity supplied by the driver would flow in the M_{fa}-R_{fa} branch. It appears that these two branches parallel each other.

4. Suppose that M_{fa} and/or R_{fa} were made so large that the air could not "blow" through the interstices of the stuffing. If the fiberglass itself were relatively mobile, the movement of the piston would force the stuffing to follow the air motion. The M_{fa}-R_{fa} branch would be essentially open circuited and all the velocity supplied by the driver would flow in the M_f-C_f-R_f branch. The two branches must be in a parallel relation to each other.

5. Other examples involving very low acoustic resistance and inertance reactance relative to the impedance of the M_f-C_f-R_f branch or very very low mechanical mass reactance, stiffness reactance and resistance (stuffing very light, very limp, etc.) relative to the impedance of the M_{fa}-R_{fa} branch also bear out the parallel relation of the two branches.

Suppose, as a further example, that C_f were made very low (very stiff fibrous material) and that R_{fa} were made extremely large. Then the air in the cavity would neither move through the stuffing nor would the stuffing itself move to any extent. It is obvious that the piston would not move and this is born out in the equivalent circuit since both the M_{fa}-R_{fa} and M_f-C_f-R_f branches would have been open circuited. It is seen from the foregoing that the equivalent circuit of (B) in *Fig.* 3 fits the results that must occur as the relative impedance values in the parallel branches are varied. Of course, in the real case for stuffing placed loosely in the cavity there is velocity in both branches. While air is moving through the fiberglass, the fiberglass is also moving relative to the enclosure walls.

The circuit of (B) is a two-degree-of-freedom system and solution of the equations governing it are, at best, tedious. It was, therefore, expedient to impose physically a special condition which reduced the circuit to that of (C) in *Fig.* 3, a simple single-degree-of-freedom system. The layers of fiberglass used in the experiment were suspended individually in a framework of heavy-gauge wire mesh as seen in *Fig.* 4. This has the effect of making C_f very low, thus stiffening the entire bulk of fiberglass and substantially preventing its motion relative to the enclosure. The M_f-C_f-R_f branch was effectively open circuited and computation becomes that for a series circuit.

The effect sought after in this experiment was heat transfer into and out of the fibrous stuffing. The rate of heat transfer between a fluid and a solid is very dependent on their relative velocity, increasing as the velocity increases. With the stuffing material held substantially immovable in the framework a certain corollary advantage was obtained. The velocity of the air past the fibers was close to the maximum available for a given piston excursion. Thus, the heat transfer was maximized by the use of the supporting framework. It must be realized that when the stuffing is merely placed loose in the cavity the relative velocity of the air past the fibers is reduced, the heat transferred per cycle is reduced and the value of n is increased over that for the rigidly held case.

Since the experimental procedure yielded a value for the total compliance seen by the force generator (voice coil) of (B) in *Fig.* 3 and it was C_a which was wanted, a preliminary experiment for determining C_m, the driver suspension compliance, was made.

From *Fig.* 6, the equivalent circuit of the driver mechanism in free air, the equation for resonance is

$$f = \frac{1}{2\pi\sqrt{(M_o + M'_R)C_M}} \qquad (10a)$$

where

C_M is the driver suspension compliance
M_o is moving mechanical mass (cone, voice coil, etc.)
M'_R is the free-air radiation mass on both sides of the piston

If an additional known mass, ΔM, is added to the moving assembly another resonance is obtained making available a second equation of the same form as Eq. (*10a*):

$$f_{\Delta M} = \frac{1}{2\pi\sqrt{(M_o + M'_R + \Delta M)C_M}} \qquad (10b)$$

From the two independent Eqs. (*10a*) and (*10b*) can be derived the expression for C_m:

$$C_m = \frac{1}{\Delta M(2\pi)^2}\left[\left(\frac{1}{f_{\Delta M}}\right)^2 - \left(\frac{f}{1}\right)^2\right] \qquad (11)$$

From Eq. (*11*) C_m was computed as 0.652×10^{-6} cm/dyne.

C_T, the total series compliance in the system (driver installed in enclosure), was found for two cases: (1), empty cavity, (A) in *Fig.* 3, and (2), stuffed cavity, (C) in *Fig.* 3. The method was similar to that for C_m, namely the addition of a known mass, ΔM, to the driver moving assembly and producing a pair of resonance equations.

With values for C_T and C_m at hand, C_a was computed for each case from

$$C_a = \frac{C_T C_m}{C_m - C_T} \qquad (12)$$

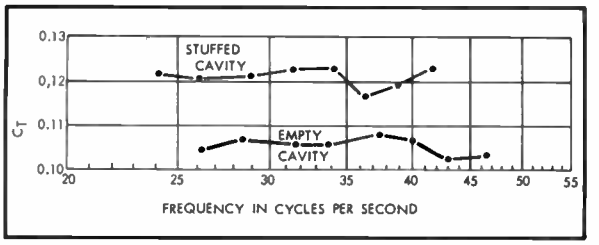

Fig. 7. Total compliance, C_T, plotted for several adjacent frequency intervals.

and knowing the net cavity volume[5] (quiescent), V_o, the driver piston area (including a correction for the motion of the surround) A, and the absolute barometric pressure at the time of the measurement, P_o, n was then computed for each case. Also the total moving mass (comprised of M_o, M_R, M_a, and M_{fa}) was computed for each case from the resonance equations.

The computations were expected to show a number of things. First, a higher moving mass was anticipated with the stuffed cavity by comparison to the empty cavity. Secondly, an n of about 1.4 was expected with the empty cavity and a smaller value, even if only somewhat smaller, for the stuffed cavity. Thirdly, the writer suspected that the isothermal effect, and, therefore, the value of n, might vary with frequency when the cavity was filled with stuffing. Consequently, it was decided to add a series of masses to the moving system with a resultant series of resonant frequencies. In this manner C_T and the total moving mass were found over a number of adjacent frequency intervals for both the stuffed cavity and empty cavity. Such an elaborate measurement in the case of the empty cavity served as a control in the experiment.

The values of C_T are plotted versus frequency in *Fig. 7*. The variation with frequency is random and small and no trend is noted. Therefore, it is concluded that under the conditions of this experiment the total compliance C_T and, hence, n remained essentially constant over the range of frequencies used. The variation is attributed mainly to error in reading the oscillator. The instrument used could be read to three significant figures only and the resonant frequencies enter the equations as squares. However, it was checked for accuracy on an electronic counter and found to be on frequency. The brass masses (note photographs) were weighed on an analytical balance to within one milligram as was the screw which fastened them to the driver assembly. The error here was judged vanishingly small.

The average value for C_T for the unstuffed cavity was computed as 0.105×10^{-6} cm/dyne, and as $C_T = 0.121 \times 10^{-6}$ cm/dyne for the stuffed cavity. The cavity compliances, C_a, computed from Eq. (*12*) using the average values of C_T are 0.125×10^{-6} cm/dyne and 0.149×10^{-6} cm/dyne for the unstuffed and stuffed cavities respectively. From Eq. (*8*), $n = 1.39$ for the unstuffed cavity and 1.18 for the stuffed cavity. The total moving mass is 92.6 grams for the unstuffed cavity and 100.8 grams for the stuffed cavity (computed from the same equations as C_T and averaged). These values are charted in Table I. The results bear out closely the expected value of 1.4 for n for the unstuffed cavity. Also, as anticipated, n is smaller for the stuffed cavity. However, n did not turn out to be equal to 1.0!

The writer's suspicion that n might vary with frequency in the stuffed cavity did not materialize. There are a number of reasons why n might be a function of frequency under certain circumstances. These reasons involve heat transfer theory and will not be discussed here.

A higher total moving mass was found in the case of the stuffed cavity as expected. The amount by which this mass increased over that for the unstuffed cavity is M_{fa}.

Standing Waves in the Air Cavity

The question has arisen again concerning the effect on frequency response of the stuffing material. The same type woofer and an enclosure of similar size to that used for the preceding experiments were used once again to record automatically two frequency-response curves, one with and one without stuffing.

The curves (*A*) and (*B*) of *Fig. 9* were run under identical conditions with the exception of the fiberglass stuffing. The curves are untouched (no microphone correction, curve tracer correction, etc.). They are intended to show only differences. The odd shape of the bass end is due mostly to the anechoic room environment.

The differences which the stuffing produced are: (1) About one db less bass output in the range of 45 to 250 cps; (2), removal of the narrow dip at 750 cps; and (3), about ½ db more output below 45 cps. This woofer is commercially used up to 200 cps only. If one wished to use it above 700 cps, it might be deemed worthwhile to use the stuffing and eliminate the dip. Actually, exclusive of that one dip, there is very little difference in the curves.

Apparatus, Instruments, and Methods

The brass weights (see photographs) were screwed securely to the threaded hard plastic dust cap of the driver. Resonance for each weight was obtained by sweeping the oscillator while observing a Lissajous figure on the oscilloscope. The figure was formed by feeding the voice coil voltage to the vertical input and the voltage across a resistor in series with the voice coil to the horizontal input. Resonance was obtained when the elliptical trace collapsed to a straight line. This method is very sensitive and very accurate.

Two backs were made for the enclosure, to one of which was bolted the fiberglass stack. The backs were pulled up tight against the rubber seal and secured with wing nuts. When the box was closed up, if the cone was fully de-

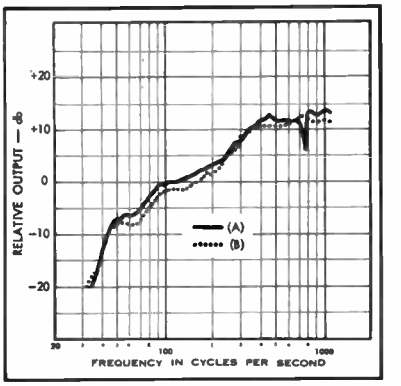

Fig. 8. Axis frequency response curves for direct-radiator closed-box loudspeaker with a 1.5-cu. ft. cavity: (A) empty, and (B) filled with loose fiberglass.

[5] In the stuffed cavity case allowance was made for volume occupied by the fiberglass and the holding framework. The volume of the fiberglass was found from its weight and density.

TABLE I

CHARTED RESULTS FOR C_m, C_T (average), C_a, n, AND M_T

	C_m, driver suspension compliance (cm/dyne)	C_T, total compliance seen at driver (cm/dyne)	C_a, cavity compliance (cm/dyne)	n, gas equation exponent	M_T, total moving mass seen at driver (grams)
Empty cavity	0.652×10^{-6}	0.105×10^{-6}	0.125×10^{-6}	1.39	92.6
Stuffed cavity	0.652×10^{-6}	0.121×10^{-6}	0.149×10^{-6}	1.18	100.8

Use of Polyester Films in Microphone Designs

To improve microphone design so as to provide wider frequency response together with lessened physical size, built-in ruggedness to withstand rough handling and usage, and means of protecting microphone units from contamination by foreign matter, designers have found polyester film a useful material.

ALEXIS BADMAIEFF*

SINCE THE ADVENT of sound recording, broadcasting and public address, engineers strive to achieve perfection in the design of various components that make up an audio channel. The amplifier, for example, has reached perfection to the degree that practically nothing can be done to improve its response characteristics. The microphone, which is the source and generator of all transmitted sounds, has likewise been going through many phases of research to perfect it to a point that will equal the excellence of electronic gear. Many types of microphones have been developed and marketed; and as one design followed another, a step by step improvement has been achieved. The Western Electric L1 microphone pressure unit was designed roughly 28 years ago and is still used this day as a microphone of quality. In practically all microphones in the past and in the majority today aluminum diaphragms have been used since this light metal is highly ductile, permitting forming into various complex shapes to achieve good acoustical performance. However, within recent years many experiments with plastic films have been made by some companies. To avoid the fragility of thin metal films, we have for some time examined various plastic films for diaphragm use and found that polyester films produce diaphragms that are unbelievably rugged, stable, and ideally suited for diaphragm material, producing a microphone that is excellent in acoustical response and approaches nearly the response of a first-class amplifier. This paper is an attempt to present the use of polyester films in specialized microphone designs which encompass the omnidirectional, the cardioid, and the lavalier.

Polyester films have a distinct advantage when formed in intricate shapes to retain that shape even though subjected to quite drastic momentary deformations. As an example, when the diaphragm made of that composition is subjected to a blast momentarily, deformation occurs but it springs back to its original shape. In contrast, an aluminum diaphragm will be permanently deformed requiring it to be replaced. Since the specific gravity of polyester is approximately 1.3 in comparison to aluminum's 2.7, the diaphragms can be made considerably thicker without upsetting the relation of masses between the diaphragm and its voice coil. The plastic diaphragm is formed under high temperatures and extreme pressures, as will be described later, so it is molecularly deformed and is expected to exhibit dimensional memory when subjected to temperature extremes, mechanical deformations, and chemical effects. The newly designed polyester diaphragms have been subjected to temperature variations from −40° F. to +170° F., cycled over long periods of time without impairment. Likewise, all commonly encountered chemical fumes have little or no effect on the structures. The diaphragms have been subjected to extreme mechanical deformations to such an extent that diaphragms have been flattened by the palm of the hand against the supporting structure and after release, still functioned properly. In addition, polyester films exhibit internal damping which contributes greatly to a smooth acoustical response when used in diaphragm construction. While aluminum diaphragms are excellent for all kinds of microphones, they are subject to easy damage by mechanical crushing by a high intensity shock wave. Because of this, microphones using aluminum diaphragms were regarded as delicate instruments, easily damaged by misuse. Polyester films are definitely not fragile; therefore, it is possible to construct microphones with non-metallic films that are out of the delicate instrument class.

In designing a diaphragm configuration, several essential points have to be taken into account. The first and most important is size. Since the diaphragm is the controlling factor in designing the magnetic structure, the size of the whole unit should be selected so that it will fit into several types of microphone cases, for instance, the lavalier, the cardioid, and the general purpose omnidirectional. It is, therefore, advantageous to design the unit as small as possible, yet retain good acoustical response, particularly in the bass region. In the case of the cardioid, additional factors must be taken into consideration. One of those factors, of course, is the all important front-to-back discrimination. Taking all the above-mentioned factors as a guide, we have designed a basic omnidirectional unit and a basic cardioid unit. By selecting various case sizes and shapes, it resulted in a new line of microphones consisting of six complete basic designs.

Omnidirectional Design

The first unit to be described is the omnidirectional. The diaphragm selected has a diameter of ⅞ in. and a thickness of .0015 in. This choice provides a happy compromise in the microphone between bulk and good low-frequency response. If the diaphragm diameter is made too small, its compliance becomes stiffer, thus raising its natural resonance. It is, of course, true that compliance can be made higher by the use of thinner diaphragm materials; but if materials are too thin, they are difficult to mold and do not retain their shape well. Likewise, miniaturization of the voice coil lowers the sensitivity of the unit because large flux densities cannot be maintained in common iron alloys without saturation. With this in mind, a diaphragm mold was constructed having a configuration which was previously computed for best possible response and a low natural resonance. By providing high-compliance hinge points in the diaphragm configuration which work together with the total mass of this structure, a resonance of 350 cps was achieved. This is mathematically shown below:

$$f_r = K\frac{1}{\sqrt{M_m C_m}}.$$

where f_r is the natural resonance, K is

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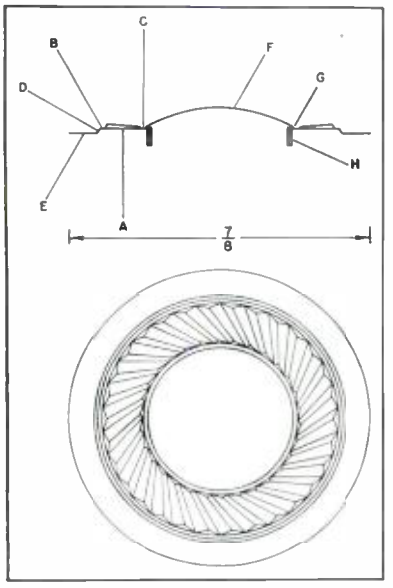

Fig. 1. Plan and cross section of the omnidirectional diaphragm and voice-coil assembly.

a constant, M_m is the mechanical inductance, and C_m is the mechanical capacitance. This is shown in *Fig.* 1. The compliance section, A, was designed to be tangential, having two hinge points, B and C, for high compliance action. To avoid special machining in the pole plate, a spacer step, D, was incorporated which terminates into a cementing seat, E. By selecting an optimum sphere radius for adequate stiffness, the dome section, F, was computed for best possible high-frequency response.

The dome section is the controlling element for frequencies above approximately 5000 cps. However, the dome alone does not do the job; it merely provides a section that is non-compliant. The actual lift of the high-frequency region is accomplished by providing a pole piece structure that will fit within the dome and entrap a sufficient amount of air so that the stiffness of air, which is an acoustical capacitance, will resonate together with the mass of the moving system at a point above the audio spectrum. This resonance, however, is broad due to acoustical resistance formed by the gap between the pole piece and the voice coil and nullifies the deficiencies of the primary resonant system.

Because of the importance of having a rigid connection between the voice coil, H, and the diaphragm, a voice coil seat has been provided as shown at G. This groove not only positions the voice coil in reference to the dome section but also provides an overlapping joint so that when cement is applied between the two parts, the adhesive forms a thin layer at the point of contact. Because of the overlapping junction, the stresses in the cement are in shear.

Diaphragm Molding

The molding of the diaphragm is accomplished by heating a metal die to a temperature that is close to the melting point of the Polyester film. When the temperature is reached, the plastic film is laid on top of the mold and compressed against the mold configuration by means of a rubber pad. A high pressure is exerted on the film while it is in its hot state to insure that all details of the mold will be reproduced on the finished diaphragm. While still being compressed, the die is cooled to room temperature at which time the pressure is released and the finished diaphragm removed from the die. Since the heat used is very close to the melting point of polyester film, a molecular formation change occurs which insures great dimensional stability.

Many research hours have been spent to determine the exact point on the temperature scale at which best and most

Fig. 2. The complete omnidirectional microphone unit without its housing.

stable formation occurs. The length of time of heating and cooling is also important. As an example, if the temperature is too high, the diaphragm will be well-formed but will have holes on its surface due to shrinkage of the film. However, when the heating time is kept short shrinkage does not occur, permitting high temperatures to be used. During the cooling cycle it was found necessary to decrease the temperature at a rather slow rate to permit equalization of stresses to occur. Final determination of the temperature change between heating and cooling was established to produce stable diaphragms on an automatic molding machine adjusted to produce one in a complete time cycle of 60 seconds.

The voice coil is part of the mass involved in the diaphragm/voice-coil assembly; in fact, it is the controlling mass and weighs more than the diaphragm alone. Therefore, to achieve good high-frequency response and in accordance with the above mentioned formula, it is obvious that the material used in the voice coil must be of minimum weight. For this reason, aluminum wire was chosen. Aluminum has the best mass-to-conductance relation. In comparison with copper, which has a specific gravity of 8.89, aluminum's specific gravity is only 2.7. The resistivity, however, is 1.64 times that of copper. The products, therefore, are for copper, 8.89, and for aluminum, 4.45, so it is readily seen that aluminum has an advantage over copper when striving for good response and high sensitivity, even though aluminum is not as good a conductor in reference to copper. Because of production simplicity, a round wire was chosen. To provide a rugged voice coil, the wire size selected was 39 gauge, wound to a total of 46 turns in two layers resulting in an impedance of approximately 8 ohms. Since rigidity again is of importance, a hard-setting cement was used to bind together the turns and layers so that the structure produced is rigid and self-supporting.

During assembly, the voice coil is carefully fitted into the voice coil seat G, in *Fig.* 1, and cemented with a hard-drying adhesive. The complete voice coil and diaphragm assembly mounted in its magnetic structure is shown in *Fig.* 2. It was designed to contain the best quality components to produce a microphone that could be used for the most critical applications such as recording, broadcasting, and instrumentation. This design was aimed at the production of units in large volumes and steps were taken to incorporate reliability in performance and in manufacture and at the same time to produce a unit that is not prohibitive in cost. This magnetic structure shown in the drawing of *Fig.* 3, having its diaphragm and voice-coil assembly cemented in place, consists of the following parts: pole plate, A; magnetic return yoke, B; Alnico *V* slug, C; pole piece, D, with a threaded portion, E. Over this threaded portion is placed an adjusting ring, F, which compresses

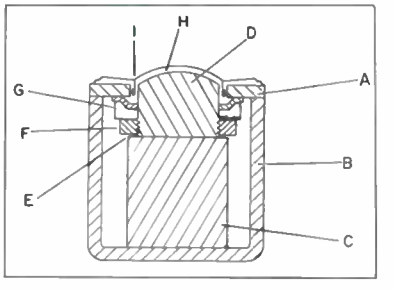

Fig. 3. Cross section of the omnidirectional unit.

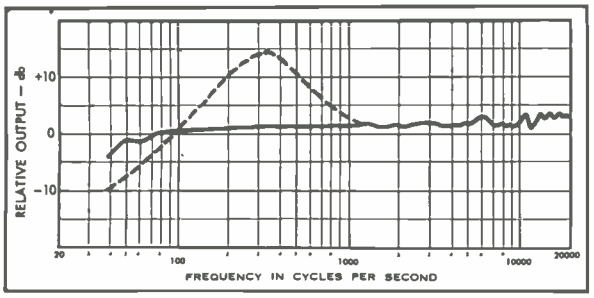

Fig. 4. On-axis response of the omnidirectional microphone. Solid line, compensated; dotted line, uncompensated, undamped.

a felt ring, G, restricting the air flow leading to the underneath side of the diaphragm, H, through the gap of the structure where the voice coil, I, is located. When the unit was thus assembled, the free air resonance of the diaphragm voice-coil assembly, as earlier calculated, was 350 cps. Ring F was then adjusted to produce an acoustical resistance in the felt ring, G, to damp the resonance sufficiently to achieve a flat acoustical response. The shape of the pole piece, D, was so chosen as to produce a sufficiently low acoustical capacitance in the space between the diaphragm and the dome of the pole piece to produce a high-frequency response that would extend to 20,000 cps. When this structure was placed in a vented housing and the vent adjusted to resonate at 50 cps, an exceptionally excellent frequency response was achieved.

Fig. 5. External appearance of the omnidirectional microphone with housing and holder.

The curve of this response is shown in *Fig.* 4, which represents the incidence on axis. The dotted portion of the curve represents the undamped, uncompensated response of the same structure. The sensitivity of the new microphone measured – 55 dbm/10 dynes/cm², which is slightly higher than the average dynamic microphone. Because of its small size the diffraction interference was extremely low as is evident in the curve when looking at the extreme high-frequency region. To avoid standing waves within the housing the interior cavity was partially filled with lambs wool, which acts as an effective sound absorber because of its high acoustical resistance.

Output Circuits

Since the voice coil impedance was chosen at 8 ohms to facilitate winding techniques and voice-coil size, a transformer was designed to raise the impedance to a higher value. Here again great care was exercised in selecting the many components that comprise a complete acoustical unit. A low-cost, light-weight transformer would have proven desirable in many ways, but perfection in end results dictated a transformer of small size wound to extreme tolerances, on high permeability iron and with low insertion loss. The secondary of this transformer has a choice of the three E.I.A. Standard values of 30/50, 150/250, and 20,000 ohms. It was then decided that if a 5-pin microphone cable connector be used, the end user could choose these impedances by merely appropriately connecting the cable plug to the pins of his choice.

A microphone of any type or design is an instrument that unfortunately has always been subjected to abnormally hard handling and usage. It is generally necessary for the user to make impedance selections within the framework of the instrument itself and in so doing risk damage to the unit. By use of the 5-pin connector for impedance selection, at no time need the technician be required to disassemble the microphone and in so doing subject it to possible damage.

The housings for the several models were designed to have adequate cavity to produce good bass response and yet be small enough for esthetic appeal. To produce a resonance within this cavity to compensate in the bass region, a vent in the form of a tube was devised. From the relation of $f_c = Kl/\sqrt{LC}$, it was found that the tube length was to be 5½ in. to produce a resonance at 50 cps. The complete omnidirectional microphone is shown in *Fig.* 5 and cross-sectional construction details in *Fig.* 6, in which A is the microphone cartridge, B is the case cavity, C is the resonator tube, D is the transformer, and E is the 5-pin connector. The final assembly of the front protective screen and case present a total length of only 7 in. to which length another 1½ in. is added for the cable plug. The resultant total length indicates a unit of attractive slim profile yet sufficiently large to be comfortably held in the hand.

Another version of a housing for a specialized use is the lavalier. This unit was designed to be of minimum size and light in weight so that when the person wears it around his neck, it would be so unobtrusive as to be virtually invisible, and would permit natural movement of the person wearing it. Because of accentuated chest sounds, the lavalier must be compensated to fall off in the bass region so that the resulting response is

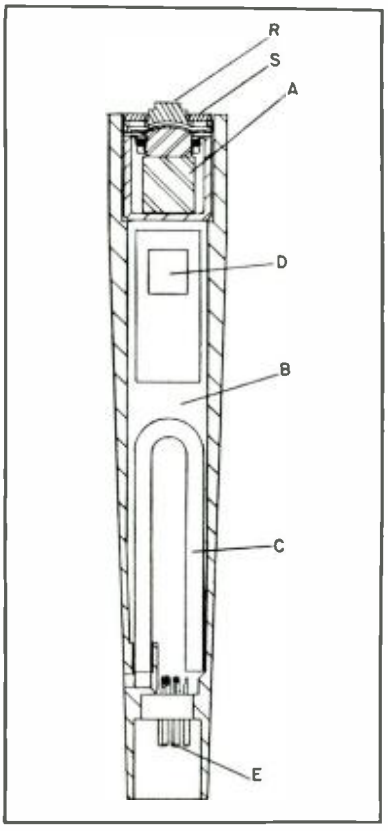

Fig. 6. Cross section of the complete unit shown in Fig. 5.

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Fig. 7. The lavalier version of the microphone.

flat. Due to this, the lavalier microphone does not need a resonating bass boosting tube in its construction and likewise does not need a large cavity behind the diaphragm.

The lavalier microphone also has a transformer to raise the original 8-ohm impedance of the cartridge to a choice of two impedances—30/50 and 150/250 ohms. Because of the importance of light weight, the plug has been omitted. A thin three-conductor shielded flexible cable terminating in a 3-pin plug is passed through a strain relief gland, which also seals the rear cavity from outside atmosphere. The choice of two impedances can be achieved by connecting the proper wires of the cable to the pins of the terminating plug. The appearance of the lavalier structure is shown in *Fig.* 7 and *Fig.* 8 is a cross-sectional diagram in which A is the microphone cartridge, B is the cavity, C is the transformer, D is the gland, and E is the terminating connector.

Design for a Cardioid

A cardioid dynamic pressure unit is vastly more complex to design than the omnidirectional. Not only does one strive for a flat frontal response but rear discrimination must also be held to a high value throughout most of the usable acoustical range. For this reason, the cardioid microphone must possess more than one sound entrance. It must have rear entrances plus acoustical phase shifting networks. The cardioid structure, designed by us, utilizes in part the principle in which cancellation or discrimination takes place down to the resonant point of the diaphragm/voice-coil assembly. This point was chosen to be 120 cps, as a point in the audible spectrum low enough in frequency to cover a large portion of the spectrum, yet sufficiently high to be less responsive to air blasts and shock. Below that point, another sound entrance is established to act as a bass boosting vent plus a bass discriminatory element to function in the region of 30 and 120 cps. Since the cardioid microphone requires a housing to operate, it shall be treated as a completed microphone assembly.

Figure 9 shows a schematic to illustrate the various sound entrances essential to the performance of such a unit. The cardioid pressure unit consists of the diaphragm and voice coil assembly, A;

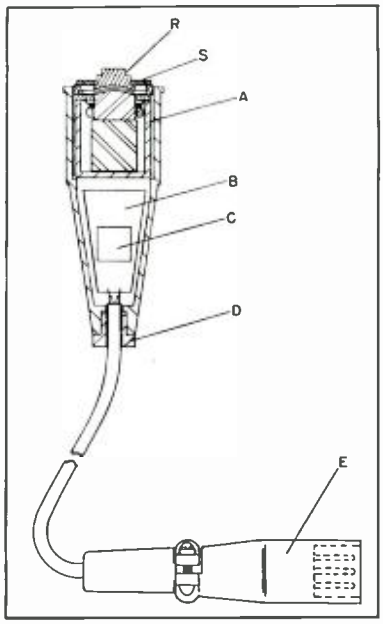

Fig. 8. Cross section of the lavalier microphone.

pole plate, B; magnet, C; magnetic return, D; high-frequency entrance, E; low frequency entrance, F, which terminates at the sound pressure mixing chamber, G; acoustical resistance, H; an anti-resonant barrier, I; cavity communicating tube, J; main cavity, K and the housing, L. The diaphragm/voice-coil assembly which is the heart of the structure is best described by showing it in a separate drawing, *Fig.* 10. For this design, the device must be mass controlled, which dictates a low resonance point to encompass as large a part of the acoustical spectrum as possible. If the resonance, however, is chosen to be too low, the structure will be too sensitive to shock excitation and currents of air. The chosen 120 cps resonance represents a compromise of those two factors. Since the mass of the voice coil and diaphragm assembly controls the sensitivity of a microphone, the reduction of the resonance can best be accomplished by increasing the compliance. This is why the cardioid diaphragm configuration contains a long compliance section, *a*, in *Fig.* 10. Otherwise, the remaining parts of the structure are very similar to the omnidirectional design. Because of this, the diameter of the diaphragm is considerably larger and measures 1.2 in. Going back to *Fig.* 9, the zero-incidence sound actuates the front of the diaphragm. At the same time, however, after some delay due to a longer path, the sound enters the high-frequency entrance, E. It, however, is further delayed by passage through the silk layer, H, and its passage through the voice-coil gap which represents an acoustical inductive component. When it strikes the rear of the diaphragm, it is in a different phase relationship in reference to the front sound pressure. To boost the bass response below 120 cps, another entrance is established at F, which is considerably further away from the rear of the diaphragm than point E. The sound entering F is lead through a tube into the mixing chamber of the diaphragm at

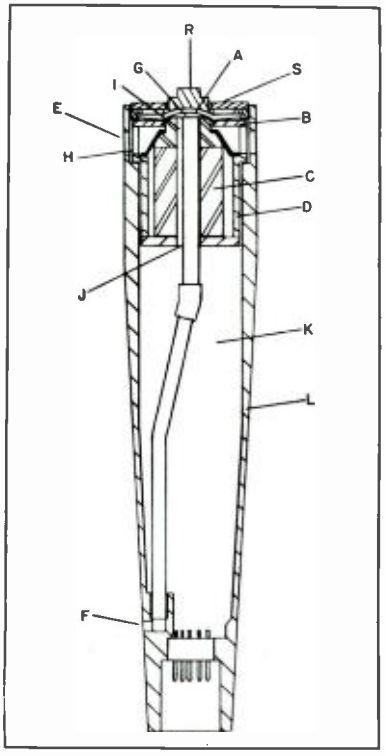

Fig. 9. Cross section of the cardioid microphone.

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It is also exemplified in the manner in which the specifications are presented. Note that the information given is complete with all qualifying data. Amplifier power ratings, for example, are for music waveforms in accordance with accepted IHFM procedure, and distortion percentages are, in each case, specified for full, rated output. FM tuner sensitivity figures are for 20 db of quieting at 75 ohms. There are no ambiguities—no significant omissions obscured by superlatives and by lengthy listings of obvious, commonplace features, which all equipment must necessarily possess.

SRB40

SRB20

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The MODEL SRB40 with its 40-watt output (20 watts per channel) was designed to meet the power requirements suggested for the new-type, low-efficiency loudspeakers. Total harmonic distortion is less than 1% (actually only 0.6% with magnetic cartridge). Frequency response extends from 20 to 20,000 cycles, ± 1 db. At 40 watts it can handle a pair of the most inefficient of these speaker systems . . . with power to spare.

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The SRB40 is fully equipped with inputs and controls to meet the functional demands of all available program sources — including special tape-head inputs with equalization. Model SRB40 ..... $269.50
Walnut Cabinet as shown (Model WE-3) 27.50
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The MODEL SRB20 is identical to the SRB40 in front-end circuitry and design. Every feature, facility and specification attributed to the SRB40 applies to the SRB20 . . . except for power output. The SRB20 with its 20 watts (10 watts per channel) delivers more than enough power to drive any system of loudspeakers intended for use in the home—including most low-efficiency types.
Model SRB20 ..... $219.50
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Walnut Cabinet (Model WE-3) 27.75

The MODEL RC412 is an instrument to command respect at any price. The need for power in excess of its total 12-watt output is rarely necessary where normally efficient loudspeakers are used. Within its power capabilities, the RC412 offers attractive economy without compromise in quality.

It is significant to note that even in the low cost RC412, the distortion is less than 1%; that its response from 30 to 15,000 cycles covers the full range of audibility, ± 1 db; and that it has 1μv FM sensitivity, two IF stages in the AM circuit, AFC and AGC on FM, AVC on AM, stereo multiplex adaptability, special recorder outputs, and hum-free dc on the low-level tube heaters. Model RC412 ..... $179.50
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RC412

ST662 in gold or grey

ST442 in gold or grey

MONO-STEREO AM-FM TUNERS

The MODEL ST662 can be counted upon to give day-in, day-out reliable reception despite weak stations, crowded wavebands and local interference. With FM sensitivity better than 0.8μv, antenna considerations become relatively unimportant and noise-free reception becomes possible even in weakest signal areas. And in the AM circuit, the use of an RF stage and two IF stages results in a terminal sensitivity of better than 3μv per meter for 20 db signal-to-noise ratio.

The FM section employs a dual limiter-discriminator circuit, and automatically provides partial interchannel hush, thus retaining tuning presence. Separate tuning indicators are used for FM and AM. And there is AFC and AGC on FM as well as AVC on AM. Flat to ± 0.5 db from 20 to 18,000 cycles, the ST662 exceeds the broadcast bandwidth capabilities of FM stations. Low impedance cathode-followers permit long amplifier connecting cables without frequency discrimination. There is also provision for adapting to stereo multiplex. Model ST662 *in gold or grey*.....$189.50

The MODEL ST442 is a sensitive, all-around instrument whose performance and smart styling would be hard to equal in any comparably priced tuner. Apartment-house reception, fringe area reception—the ST442 with its 1μv sensitivity, takes them in its stride—and performs with a reliability that bespeaks the good design and quality which have gone into making it an outstanding value.

Except for a single limiter-discriminator FM circuit and a tuning meter instead of two indicators, the ST442 and ST662 are identical in all other essential features: AM sensitivity, AFC, AGC and AVC, low impedance cathode-followers, stereo multiplex adaptability, and frequency response. Model ST442 *in gold or grey*.....$149.50

Metal Enclosure and Legs for either ST662 or ST442 as shown with ST662 (Model BEG) 7.50
Walnut Cabinet for either ST662 or ST442 as shown with ST442 (Model WE-2) 23.50

DB230A in gold or grey

DB212 in gold or grey

MONO-STEREO AMPLIFIERS

The MODEL DB230A with less than 1% distortion at 60 watts (30 watts per channel) and ± 0.5 db response from 20 to 20,000 cycles, delivers more full-range distortion-free power than is needed for the most inefficient speaker systems.

Several additional design features deserve attention: controlled positive feedback for optimum damping and stability; phono-mix switch for adapting stereo cartridges to mono records; switched hi-lo cut-off filters; volume plus loudness controls; separate recorder outputs; speaker phasing switch; and inputs for every program source, including equalized tape-head inputs. Uses pure full-wave-rectified dc on low-level filaments. DB 230A *in gold or grey* $189.50
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Walnut Cabinet (Model WE-1) 24.75

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Frequency response is 20 to 20,000 cycles ± 1 db; distortion, less than 1%. Also included: equalized tape-head inputs, switched hi-lo filters, separate recorder outputs, speaker phasing switch, and dc on low-level filaments. Model DB212 *in gold or grey* $119.95
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Metal Enclosure and Legs (BEG)..... 7.50

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Model PR2 *in gold or grey* $99.50; Metal Enclosure and Legs as shown (Model DEG) $7.50

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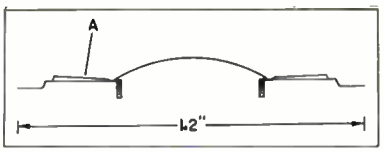

Fig. 10. Section of the cardioid diaphragm and voice-coil assembly showing the long compliance sections necessary for low resonance.

G. This tube has two functions; the first is to provide a remote pickup point and also to act as an inductive component to resonate with the main cavity, K. Now, let us consider the action of this microphone when the sound is coming from the rear. Above 120 cps sound first enters the high-frequency entrance, E, where it is delayed as previously explained. It also travels a longer distance until it finally actuates the front of the diaphragm. Because of delay to the mixing chamber, G, both sound pressures strike both sides of the diaphragm at the same instant and, thus, cancel each other. Below 120 cps a similar condition exists; but in this case, sound also enters the low frequency entrance, F, where it is delayed and produces a cancelling effect as in the case of the high-frequency entrances. The resultant pickup pattern is in the form of a cardioid throughout the usable audio spectrum. The analogue of this microphone is shown in *Fig.* 11 and together with its separate text is self-explanatory.

Response Adjustment

The adjustment of the cardioid microphone for best front-to-back discrimination is accomplished by means of adding more or less acoustical resistance in the high-frequency ports and the remote bass pickup point. Covering the high frequency ports with one, two, or three layers of dense silk material it is possible to find a null point for the sound coming from the rear. This adjustment affects the range of between approximately 300 and 5000 cps. The range below 300 cps is adjustable by means of inserting lambs wool of the right length and density into the bass tube to provide best descrimination in the bass region. The discrimination above 5000 cps is fixed and is the function of the baffle effect due to the configuration of the microphone structure. When all parameters are correctly adjusted, the resultant response is shown in *Fig.* 12, which shows the front response labelled 0 deg. and the back response labelled 180 deg. It will be noted that on the frontal response a dotted hump appears centering at 3000 cps. This hump in the frequency response is due to the resonance of the long compliance section necessary to achieve a low natural resonance of the diaphragm and voice-coil assembly. Since it is difficult to correct this acoustically, the hump is nullified by the use of an LC electrical network across the voice-coil terminals. This circuit consists of simply a choke and a capacitor connected in series and a resistor to control the "Q" of the network. With this adjustment made, the resultant frontal response appears as the solid curve in *Fig.* 12.

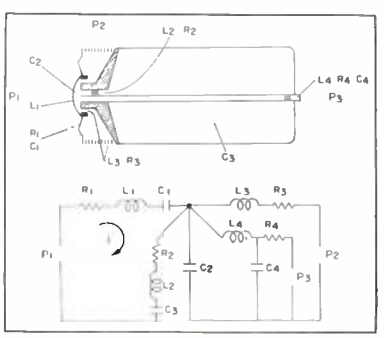

Fig. 11. Schematic cross-sectional view of the cardioid microphone and its electrical analog.

P_1 is the frontal sound pressure; R_1, L_1, and C_1 are radiation resistance, mass, and compliance of the diaphragm. C_3 is the housing cavity. R_2 and L_2 is the communicating entrance between the diaphragm mixing chamber and the housing cavity. C_3 is the acoustical capacitance underneath the diaphragm. L_3 and R_3 are the acoustical inductance and resistance of the voice-coil gap and silk over the high-frequency port entrances, P_2. L_4, R_4, and C_4 are the lumped inductance, resistance, and capacitance of the low-frequency port entrance, P_3.

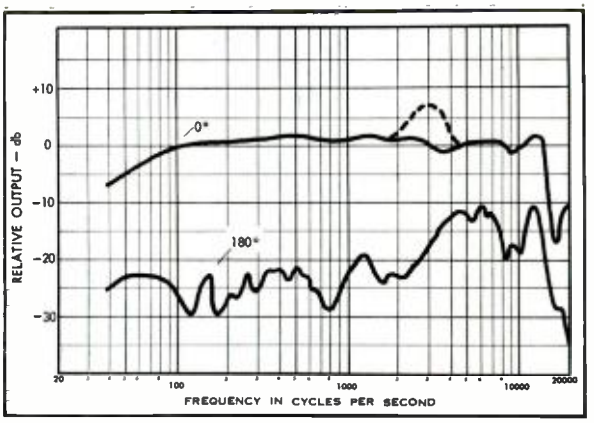

Fig. 12. Front and rear response of the cardioid microphone when properly adjusted for good discrimination.

At the output terminals of the voice coil shunted with its network, an impedance-matching transformer is used to present to the consumer three normally used impedances as in the case of the omnidirectional microphone. The output, again, is terminated by a 5-pin connector whereby any of these impedances can be wired-in at the plug at the end of the cable. The cardioid microphone together with its holder is shown in *Fig.* 13.

One of the most distinctive features of the new microphone line which has not been previously mentioned is the use of sintered metals placed ahead of the front of the diaphragm for the purpose of protection against any foreign particles such as ferrous filings, dust, and water. This specialized sintered material is made of minute bronze spheres that are tacked together, under pressures, to form a plate, in this instance 1/16-in. thick. For many years we have used this sintered bronze for microphone protection, and from continuing experiments on this and other materials have conclusively proven that at the present state of the art, no other protective means against damaging foreign matter even closely approximates the sintered bronze filter in both protective and acoustic qualities. The result is a material in which porosity can be rigidly controlled by choosing the correct size of the spheres that make up the plate. Since such a material is also an acoustical resistance having a fair amount of acoustical inductance, it was necessary to raise the high-frequency response of the described microphones beyond 10,000 cps. A small acoustical resonator cap is provided in front of the diaphragm dome to add an additional acoustical capacitance which together with the diaphragm mass resonates beyond 20,000 cps. Since the bronze filter lowers the response in that region and the resonator cap boosts the response at the same region, the net result is flat. In the cross-sectional drawings of the three microphone types, the resonator is labeled R and the filter S.

In addition to the sintered screen fil-

(*Continued on page 60*)

Fig. 13. The cardioid microphone with its housing and holder.

Distortion in Tape Recording

HERMAN BURSTEIN*

Types and causes of distortion should be understood by the recordist if he is to obtain the best results. Various compromises are shown to be effective under different conditions.

IN TWO PARTS—PART TWO

Tapes differ somewhat in their distortion characteristics. This is illustrated by a test that was made of four brands of conventional tape. At a relatively high recording level, the input signal was adjusted in each case so as to produce the same output level in playback; after all, it is the playback level in which we are ultimately interested. At the same time, bias current was adjusted so as to produce minimum IM distortion. The results appear in Table 1. While the differences in distortion are not profound, still the difference between minimum and maximum IM, 3.4 per cent, is not insignificant. On the other hand, Tape A would not necessarily be one's choice, assuming that one goes by laboratory tests. It would further be necessary to investigate the tape's characteristics with respect to frequency, noise, and other factors.

A high-output tape was tested in the same manner as the four conventional tapes just discussed. In this instance, minimum IM distortion was only 3.5 per cent, a substantial improvement.

The ability of the tape to accept a high recording level without serious distortion varies somewhat with frequency. At a tape speed of 7.5 ips, it appears that there is a rise in the amount of signal which can safely be presented to the tape. The rise starts at about 1000 cps and attains a maximum of some 4 or 5 db. The nature of this rise may vary among brands and kinds of tape. Conversely, it is indicated that the acceptable signal decreases at the low end of the audio range. *Figure* 4 suggests in approximate and relative terms the permissible recording signal that may be presented to the tape at various frequencies for the same amount of distortion. In view of what happens at the low end, it may be advisable to record at a somewhat lower level than usual when dealing with a sound source dominated by low notes.

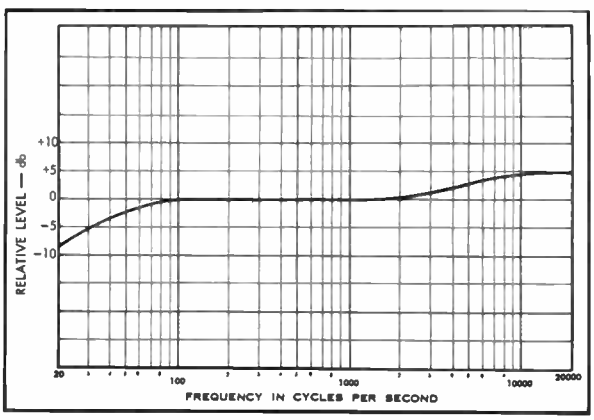

Fig. 4. Relative permissible recording level (approximate) at various frequencies at 7.5 ips.

Distortion and the Record-Level Indicator

To record at a level high enough for a good signal-to-noise ratio yet low enough for tolerable distortion depends a great deal upon the record-level indicator. This may be either of the electronic-eye type, which indicates peak recording level, or of the meter type, which tends to indicate average level. In either case, it is of paramount importance that the meter be properly calibrated in the sense of indicating accurately when maximum recording level is reached. Thus an electronic eye that is supposed to close at a level producing 3 per cent harmonic distortion but actually does so at 6 per cent can account for an unsatisfactory recording in terms of clean reproduction. On the other hand, an eye that closes at a level resulting in only 0.5 per cent harmonic distortion would lead to very clean

* *280 Twin Lane E., Wantagh, N. Y.*

TABLE I

Minimum Level of IM Distortion Obtainable With Four Brands of Conventional Tape at a High Recording Level

Tape	Minimum IM Distortion %
A	7.6%
B	9.0
C	11.0
D	10.0

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Uni-directional and omni-directional : Maximum front to back sensitivity of more than 15 db provides unequalled Cardioid pattern.

Output Impedance : 200 ohms balanced
Output Level : Uni directional—50 db
Omni-directional—52 db

* Actual anechoed response curve and descriptive brochure available upon request!

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RADIO Wireless MICROPHONE

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- Detachable small dynamic microphone
- Can be held, used as lavalier, or concealed
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RECEIVER

- Small size and lightweight, very attractive for desk use
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recordings but probably with an unnecessarily low signal-to-noise ratio.

Accordingly, the individual who is meticulous about the maintenance of his tape recorder will see to it that on occasion the calibration of the record level indicator is checked and adjusted if necessary.

The VU meter presents a special problem. The electronic-eye indicator has an advantage in that it indicates the peak level of the signal (although the meter has other advantages discussed in an earlier article.) In the case of the VU meter, which tends to indicate average level, it is necessary to allow for the inability of the pointer, a mechanical rather than electronic device, to follow rapid signal changes. Hence the VU meter understates maximum signal level. Accordingly, it is important that an offsetting adjustment be made in the calibration of the VU meter. This means that the meter should be adjusted to indicate maximum permissible recording level when the average signal (or a steady sine wave) is actually about 6 db to 10 db below the level that would cause maximum permissible distortion. Thus the meter "reads ahead," providing a safety margin to compensate for the fact that signal peaks tend to be much higher than the average signal level. Even with this safety margin, the recordist must employ experience and judgment in setting his recording level.

Distortion and Frequency Response

With rising frequency there are increasingly severe losses that take place in the recording process. These losses have to be made up by treble boost in the record amplifier. In many tape machines this treble boost goes beyond 20 db by the time the upper end of the audio range is reached. Such amounts of boost carry with them the danger of overloading the tape.

To a substantial extent the danger is mitigated by the fact that in most musical material the amplitude of the high frequencies is considerably less than that of the middle frequencies. *Figure* 5 shows for a typical orchestral selection the relative peak amplitude of frequencies over the audio range; while it should be kept in mind that this figure applies only to one particular orchestral selection, nevertheless it is typical. To the extent that the high-frequency peaks are lower than the peaks of the other frequencies, there is an offset to treble boost used in recording.

However, in many musical sources the relative amplitude of the high frequencies may be considerably greater than shown in *Fig.* 5, so that excessive distortion may occur in recording unless the recording level is appropriately reduced.

The problem of excessive treble signal is often raised by the fact that in recording a phono disc (ultimately reaching the audiofan via a broadcast and then transferred by him to tape) the engineers may deliberately emphasize the treble range or a portion of it in order to impart a false brilliance that is frequently mistaken for high fidelity. It may be possible for the tape recordist to reduce this false treble boost, or some part of it, by means of the treble control in his control amplifier before the signal reaches the tape recorder. This can be done in those control amplifiers where the tape output jack is located after rather than prior to the tone controls.

A substantial part of the treble losses in recording are due to bias current. To reduce these losses and cut down the need for treble boost, it is expedient to reduce bias current. Unfortunately, reduced bias causes an increase in distortion. Were it not for the necessity of preserving treble response well out to the upper limits of the audio range, it would be feasible to increase bias and minimize distortion.

Distortion may also be traced occasionally to the desire to preserve response at the bass end. To maintain flat response to 50 cps and below, a slight amount of bass boost is often employed in recording. This boost reaches 3 db at 50 cps and increases as frequency declines. But, as mentioned previously, the tape is more susceptible to overloading at low frequencies than in the mid-range. If the sound source contains an abundance of very low frequencies at high amplitude, distortion may be appreciable unless, of course, care is taken to reduce the recording level.

Distortion and Equalization

Tape recorders require bass boost and treble boost, as indicated by *Fig.* 6, which shows the record-playback response of a tape machine at 7.5 ips in the total absence of equalization. The manner in which equalization is supplied affects distortion. For minimum distortion, bass boost should take place entirely or mainly in playback. Bass boost in recording imposes an excessive magnetic field on the tape. However, a number of tape machines employ half-and-half equalization, which consists of equal and ample amounts of bass boost in record and playback; and similarly for treble boost. The NAB standard, which applies to 15 ips recording, stipulates that bass boost shall take place essentially in playback.

For minimum distortion, it would be desirable to provide all or most of the necessary treble boost in playback. But this conflicts with signal-to-noise considerations. Playback treble boost emphasizes the noise of the playback amplifier, reducing the signal to noise ratio. Accordingly, it is the practice of quality tape recorders, in conformity with the NAB standard, to supply treble boost essentially in the recording process. Correspondingly, it becomes desirable to employ a pattern of equalization which minimizes the treble boost required in recording, thereby minimizing distortion.

The pattern of equalization revolves about the choice of a turnover frequency.

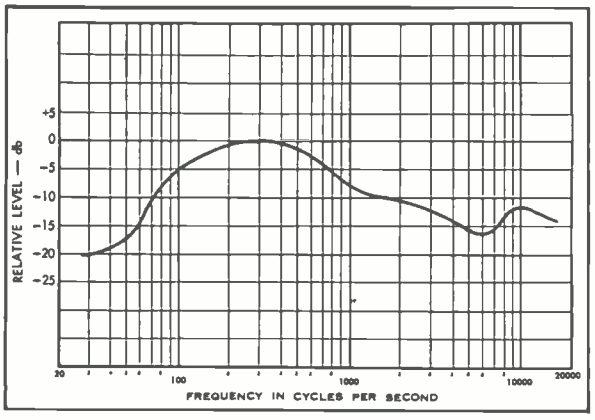

Fig. 5. Relative peak amplitude of various frequencies for a typical orchestral selection.

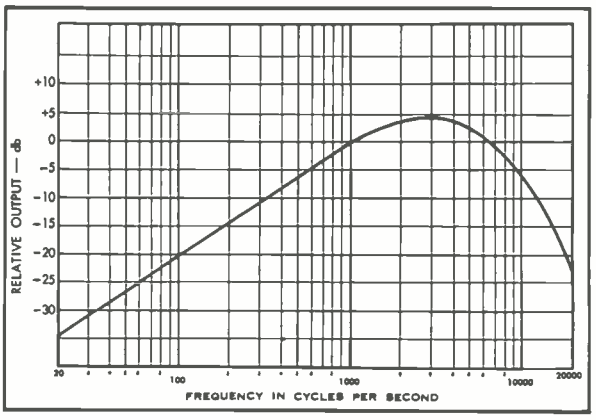

Fig. 6. Typical unequalized record-playback response of a tape machine operating at 7.5 ips.

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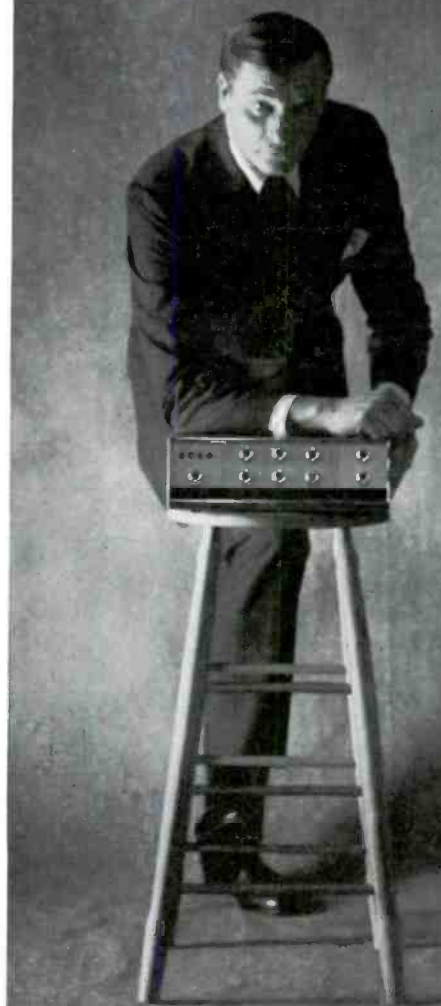

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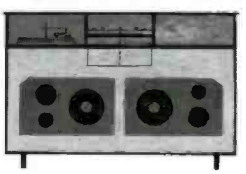

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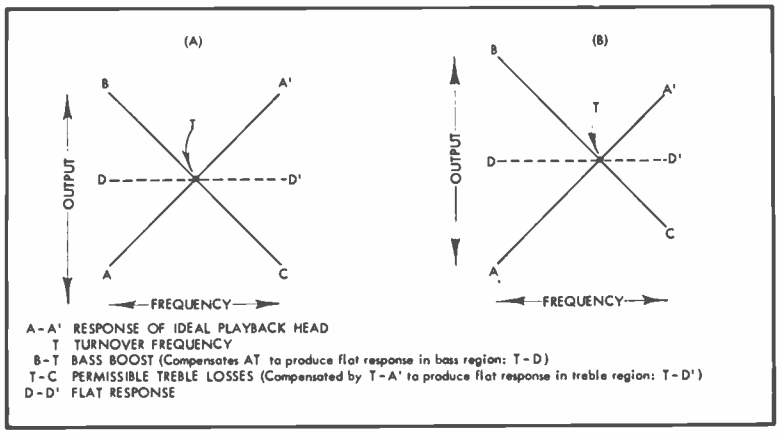

Fig. 7. Patterns of equalization in a tape machine.

It is possible to employ varying patterns of equalization, each with a different turnover frequency, entailing different amounts of treble boost and therefore different amounts of distortion.

This may be explained with the aid of *Fig.* 7. Output voltage of an ideal playback head rises steadily with increasing frequency, as shown by curve A-A′. This upward sloping line may be viewed as either treble boost or bass cut, depending upon our standard of reference, namely the turnover frequency, which is labeled T. The portion of the line above T may be said to represent treble boost, while the portion below T represents bass cut.

If the turnover frequency is low, as at (A), this signifies that bass boost begins at a low frequency. Thus the bass boost in playback, B-T, compensates the bass droop A-T of the playback head. And the rising response T-A′ of the playback head compensates the net recording loss (after treble boost) T-C. The large rise of T-A′ in (A)—resulting from the choice of turnover frequency—signifies that substantial treble losses are permissible in recording. This in turn means that less treble boost need be used in recording, which leads to less distortion.

(B) in *Fig.* 7 represents a different pattern of equalization, one with a high turnover frequency. Consequently the playback head supplies less treble boost compared with the scheme of things in (A). This signifies that less treble loss is permissible in recording, thereby necessitating more treble boost in recording and greater distortion. (On the other hand, the equalization pattern of (B) permits a better signal-to-noise ratio because more signal is recorded on the tape and because there is greater de-emphasis of the treble frequencies—the noise region—in playback.)

The pattern of equalization is not a matter for the tape recordist to decide. It is an industry decision. At the time of writing the question of suitable equalization patterns (turnover frequencies) for the tape speeds principally in home use, namely 7.5 and 3.75 ips, was still unsettled and undergoing discussion by industry committees. But it does not appear that the equalization patterns ultimately settled upon will vary greatly from those in present use. There is a good chance that the turnover frequency (at which bass boost commences) of 3180 cps commonly used at 7.5 ips will become an official standard. In the case of the 3.75 ips speed, turnover frequencies of either 795 cps or 1590 cps have often been used. At the time of writing there was a proposal before the industry to use a turnover of 1326 cps. This kind of compromise would permit playing older tapes with a fairly minor deviation from flat response; and this kind of deviation could be corrected fairly well by means of audio system tone controls.

Distortion and Bias Current

Figure 8 shows how harmonic and IM distortion vary with changes in bias current. We are concerned with the area to the right of the −7 db point; it is not practical to record in the area to the left—that is, at small values of bias current—because somewhat less signal is then recorded on the tape. Restricting ourselves to the practical area of operation, the following conclusions can be drawn from *Fig.* 8.

1. With increasing bias current, distortion declines steadily to a minimum level and eventually rises again.
2. IM distortion is greater than harmonic distortion.
3. The changes in IM distortion with changes in bias current are sharper than the changes in harmonic distortion.
4. The greater the signal level recorded on the tape the more critical is the bias setting for minimum distortion.
5. An increase in signal level produces the least increase in distortion when bias is set for minimum distortion.

It is apparent from the foregoing that proper bias setting is of great importance in minimizing distortion. On the other hand, as brought out before, it is necessary to take into account that treble losses increase as bias is increased, and that such losses grow more severe as tape speed is reduced.

Distortion and Tape Speed

To reduce treble losses and make it possible to achieve frequency response approximating high fidelity requirements, it is necessary at certain tape speeds to reduce bias below the point

(*Continued on page 70*)

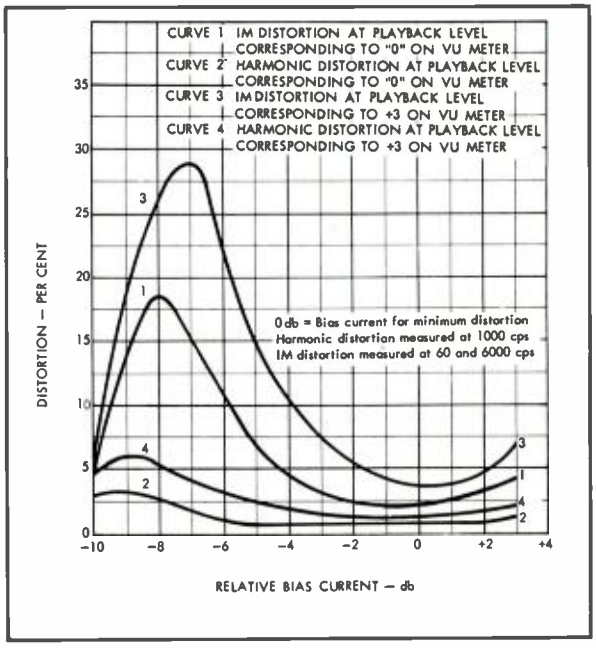

Fig. 8. Variation of tape distortion with changes in bias current.

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The speakers shown above may be heard at AR's permanent display, the AR Music Room on the west balcony of Grand Central Terminal, New York City. Literature on any or all of these models is available on request.

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EQUIPMENT PROFILE

KNIGHT-KIT DELUXE STEREO TUNER AM-FM

Just imagine building a complete AM-FM tuner in 13 hours—from unpacking the parts to listening. But that is just what we were able to do with the new Knight-Kit Deluxe Stereo Tuner shown in *Fig.* 1. Handsome in appearance, easy to construct, and excellent in performance, this kit employs printed circuits almost everywhere—excepting only the power supply section—which makes assembly as simple as threading wires through holes. In addition, the circuit of the FM section employs the Dynamic Sideband Regulation system which reduces distortion that might arise in the tuner itself. Furthermore, space is provided in the chassis for a multiplex adapter when the time comes without the need for adding an extra cabinet when the hoped-for day arrives. Too, if there is no immediate need for AM (or if the budget can't be stretched quite enough for the complete unit), the basic tuner chassis, panel, and the FM section may be purchased separately, and the AM section may be added later at a cost differential of only two dollars over the complete stereo tuner in one order.

Circuit Description

The FM section comprises two separate printed circuits—the front end being on one and the i.f. and discriminator on another. The circuit employs a 6X8 pentode section as r.f. amplifier and the associated triode section as mixer, a 12AT7 as oscillator and reactance tube, two 6CB6's as i.f. amplifiers, two 6AU6's as limiters, a 6AL5 as discriminator, and a 12AU7 as a.f. amplifier and cathode follower output. An EM84 is used as a combination dial and tuning indicator.

The AM section employs a 6BA6 as r.f. amplifier, a 6BE6 as converter, a second 6BA6 as i.f. amplifier, and a 12AU7 with one section as an infinite impedance detector and the other as cathode follower output. A second EM84 is used as dial and tuning indicator for the AM section.

The power supply uses a 6CA4 as rectifier, with RC filtering employing 110 μf of capacitors. A rotatable ferrite loopstick is provided for AM, and terminals are furnished for connection to an external FM dipole.

Physically the unit is housed in a steel case 4⅛ in. high, 15½ in. wide, and 16½ in. deep, with an external finish of permanently bonded cordovan gray vinyl. The front panel is heavy extruded aluminum, gold-anodized, with beige and white highlights. The panel mounts two dual concentric controls and four slide switches. The small knobs serve for tuning—the AM at the right and the FM at the left—while the outer left knob is a function control with four positions—AM, FM, AM-FM, and Multiplex. The large knob at the right controls the "dimension" when used with the future multiplex adapter—in its present form the control is not wired, although it is furnished, and in place.

The slide switches at the left have OFF and ON positions for a.f.c. and for the Dynamic Sideband Regulation circuit; those at the right are the AM narrow-broad control and the power switch.

The DSR feature works somewhat in the same manner as the a.f.c. circuit in that a form of feedback is employed. In the a.f.c. circuit, the d.c. potential at the output of the discriminator is fed back to the reactance tube, which in turn varies the effective capacitance (or inductance, as the case may be), changing the oscillator frequency so as to bring the discriminator potential to zero. As in any governor action, it cannot be perfect, but it is sufficiently close in operation that the width of the i.f. amplifier pass band is readily accommodated. For a.f.c. use, it is a well filtered d.c. potential that is fed back. In the DSR arrangement, the audio signal is fed back to the reactance tube without any filtering (although if the a.f.c. circuit is on at the same time the discriminator d.c. potential is superimposed on the signal voltage that is fed back). The effect is similar to any feedback in that distortion originating within the amplifier is fed back to the input to reduce the distortion. The fact is that it does work, even though it might seem improbable, and on high percentages of modulation the quality is definitely cleaner with DSR circuit on than it is in the off position.

The AM section is fairly conventional, with the possible exception of the use of the infinite impedance detector, which is well known for low distortion. Diodes fed from the plate of the infinite impedance detector (with a fairly low plate load) develop the a.v.c. voltage. This connection eliminates the loading—and consequent distortion—when the diodes are connected either to the plate of the i.f. tube or in parallel with the detector circuit. The broad-narrow control operates by changing the coupling of both i.f. transformers; in the over-coupled position the bandwidth is greater.

The indicator tubes are mounted on a sliding carrier operated by the dial cord. The in-tune position is indicated by a narrow dark line which simultaneously shows the dial setting; the dark line broadens as one tunes off the station. This arrangement provides both tuning indication and illuminated dial indication at the same time.

Performance

FM sensitivity is rated at 2.5 microvolts for 20 db quieting, which is more than adequate for all but fringe areas. By comparison with other tuners, it appears that this unit reaches its specification easily. Output from local signals is 1 volt at 30 per cent modulation, with peaks of 2.5 volts being noted on high-level signals. The output voltage is adjustable from both sections by means of rear controls.

The AM sensitivity with the ferrite loop is rated at 120 μv for a 10-db signal-to-noise ratio, which checks with other tuners. With an antenna, sensitivity is considerably greater, the rating being 3 μv. Output is approximately the same as the FM section, and in the wide position there is a noticeable broadening of the pass band. Hum on both sections measured at 62 db below 1 volt.

Construction

With most of the circuitry being by means of printed circuit boards, the entire unit goes together very rapidly. *Figure* 3 shows the top of the unit out of the case to show the placement of the various sections. The AM section and the FM front-end are on the two panels nearest the front of the tuner, while the FM i.f. section extends the full width of the unit just behind the other two panels. The power supply and space for the multiplex adapter are at the rear of the chassis.

All observations and measurements were made without touching any of the transformers, which are all pre-tuned. Even the r.f. coils are closely pre-tuned, with small protrusions on the sides of the wires controlling how far they may be pushed into the printed circuit panel—a very neat method. The only adjustments necessary

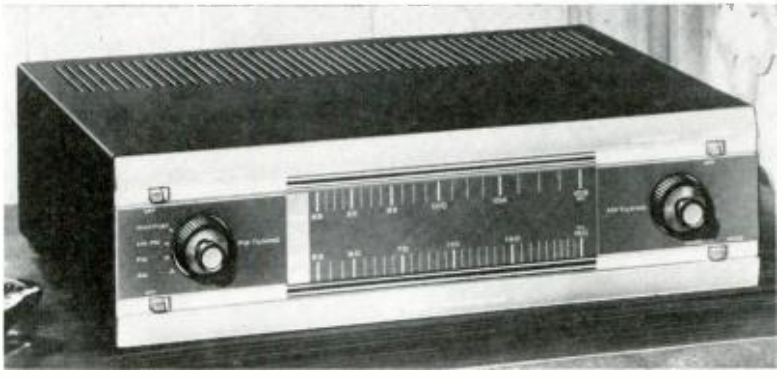
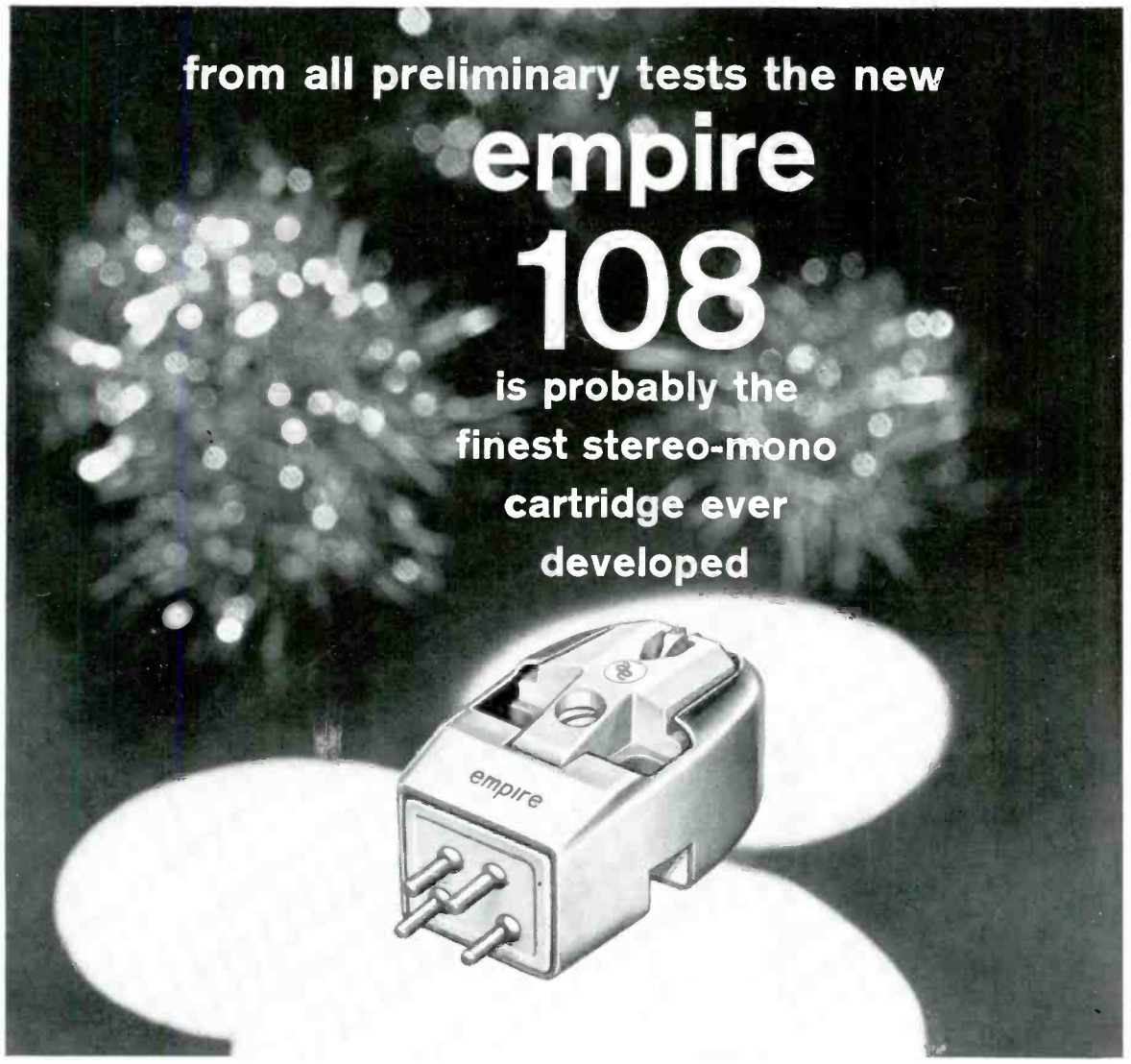


Fig. 1. Knight-Kit Deluxe Stereo FM-AM tuner—Model 83YX731.



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Empire 108 performance specifications: Frequency response: 15—30,000 cycles ± 2 db • Output voltage: 8.0 millivolts per channel balanced to within ± 1 db • Channel separation: More than 25 db • Compliance: Vertical and horizontal 6×10^{-6} cm/dyne • Recommended tracking force 1.5 to 5 grams • Terminals: 4 terminal output.

Fig. 2. Knight-Kit Deluxe Stereo Amplifier—Model 83YX774.

were the FM oscillator padder to make the dial track, and the natural trimming of the antenna and r.f. capacitors, all done aurally. Similar accuracy obtained with the AM section.

After completion of measurement and preliminary observations, the unit was checked by a sweep generator and 'scope with only infinitesimal improvement—no more than could normally be obtained on two consecutive alignments performed by the generator-'scope method.

KNIGHT-KIT 40-WATT STEREO AMPLIFIER

Matching the stereo tuner in appearance and width, the dual-20 stereo amplifier-preamplifier makes an ideal companion piece for it. Again using multiple printed circuits, the amplifier builds almost as easily as the tuner, requiring a little over 14 hours for completion. *Figure* 2 shows the external appearance, and *Fig.* 4 is a view of the underside to show the "front-end" tubes and the expanded area for input and output connections—a problem with compact amplifiers because of the multiplicity of connections.

Each circuit uses a 7025 as a preamp, followed by the triode section of a 6CM8 as tone-control driver and the pentode section of the 6CM8 as a voltage amplifier. These are followed by a 12AX7 as a long-tailed pair serving as phase splitter and driver, with a pair of 6973's as fixed-bias output tubes. A GZ34 is used as a rectifier. Separate filament windings are used for the two sections, with individual hum controls on each. Inputs are provided for tape head, magnetic and ceramic phono pickups, tuner, and auxiliary, with recorder outputs following the loudness and balance controls, but ahead of the tone controls. Speaker output impedances of 4, 8, and 16 ohms are provided on both channels, and by grounding the center tap of the output transformer secondaries (rather than one end) a combined output—commonly called "center channel"—is available for either 8- or 16-ohm speakers.

Wiring to the switches is considerably simplified by the use of switch types which actually plug into the printed circuits and make all the connections at once. One of the greatest problems for the beginner in wiring is that of making the numerous connections to multi-deck rotary switches. It is not really difficult, but it does require some practice to make neat and effective connections without an occasional dribble of solder down between the contacts. Once that happens, the switch might as well be discarded. With printed circuit switches one would have to try awfully hard to get solder into the switches, since all connections are made to extended pins on the underside of the printed-circuit panel—well away from the switch.

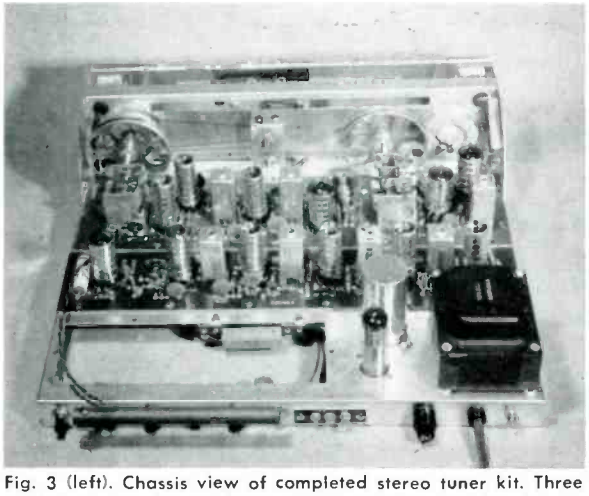
Front panel controls include the selector with four positions, the mode switch with six positions, separate bass and treble tone controls for each channel (dual concentric so both may be turned at once very easily), balance, and level or loudness. Four slide switches provide for rumble filter, scratch filter, loudness compensation, and power.

Inputs of 2.2 millivolts at tape head and magnetic phono inputs will give rated 20-watt output, with the tuner input requiring 0.3 volts and the auxiliary input requiring 0.7 volts for the same output. Harmonic distortion was measured at 0.42 per cent (at 1000 cps) for 20 watts output on one channel and 0.37 per cent on the other. IM distortion measured 1 per cent at 23 and 24 watts respectively, with IHFM power bandwidth measured at 25 cps to 45,000 cps. Crosstalk between channels at 1000 cps measured −48 db, and −42 db at 10,000 cps. Music power output at 1 per cent measured 24 watts on one channel, 26 on the other.

Construction

Instructions furnished with Knight Kits are among the clearest to be found. Not a single thing seems to be left to guesswork. In building any kit, we use no special tools not "timesaving" devices, but actually build them as practically anyone else would—on the kitchen table (much to the consternation of the rest of the family). With some complicated units it would be desirable to use chassis cradles or some such convenience, but for the average kit we feel it should be built *exactly* from the instructions, with no deviations. Knight Kits have an interesting and effective way of indicating the length of lead to cut for a given "run"—they simply specify a red wire or a green wire or a blue wire. The wires furnished with the kits are already cut to lengths in multiples of 1 in., and all wires of a given color are the same length. This saves the notation "cut a 7¾-in. green wire and . . ." and although it clutters up the color coding to use this method, it is much simpler. The only possible disadvantage is that when a 7¼-in. lead is required it is necessary to specify a gray wire (8 in.), and this may leave a little too much slack for neatest construction.

With both of these units, however, anyone should be able to turn out a finished product that looks as though it were factory built. We consider them well designed and easily constructed, and their finished appearance and performance is quite acceptable. And after all, there is a considerable saving in kit building—imagine an AM-FM stereo tuner *and* a 40-watt



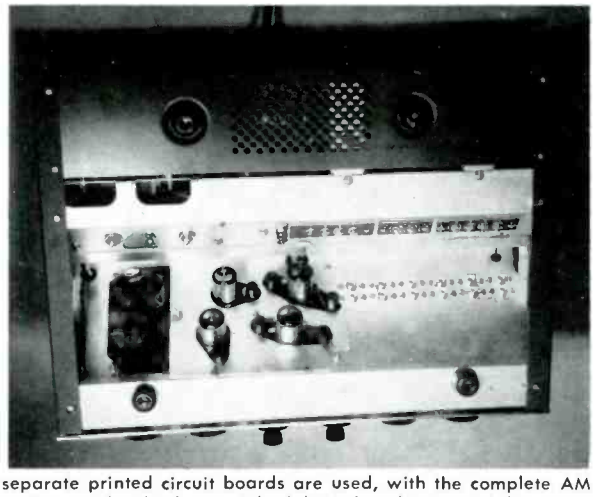
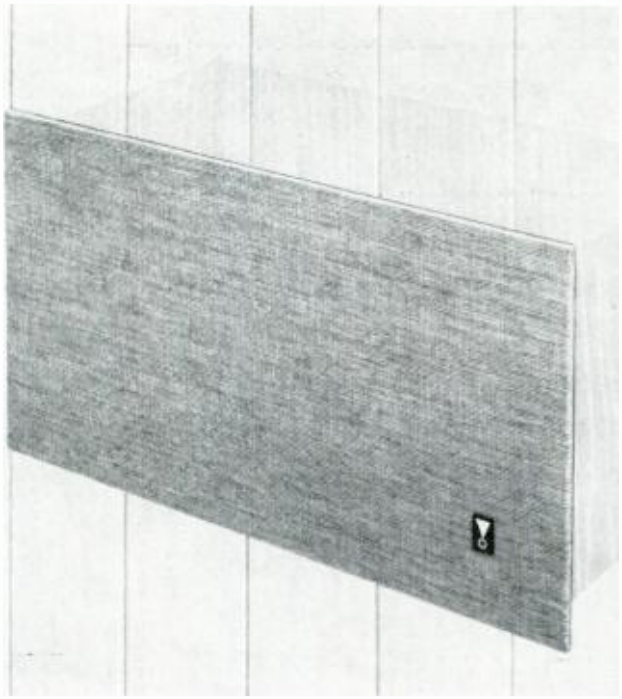


Fig. 3 (left). Chassis view of completed stereo tuner kit. Three separate printed circuit boards are used, with the complete AM section on one, the FM front end on another, and the FM i.f. section on the third. Fig. 4 (right). Underside view of the stereo amplifier to show wide expanse of space for output terminal strips and input jacks.



NEW JBL UTILITY ENCLOSURE FOR BUILT-IN AND CUSTOM INSTALLATIONS

"What's the best way to build a JBL Linear-Efficiency Speaker into a wall or cabinet?" This is the question most frequently asked of us since the introduction of the precision-made, long-linear-excursion, relatively-high-efficiency JBL loudspeakers. The answer is provided in the new Wilton systems. The Wilton is a minimum-volume acoustical enclosure for use with either the LE8, eight-inch, full-range, Linear-Efficiency Speaker (System D47LE8) or with the S5 two-way, network-divided Linear-Efficiency System (D47S5). It must be ordered with a system factory-installed; it is never available separately. The Wilton is an unfinished birch enclosure measuring 11¾" x 23¾" x 11¾". The surface is sanded at the factory on four sides ready for finishing, and may be used as a free-standing enclosure either vertically or horizontally. You have your choice of either a flush-mounted grille for this use or an overlapping grille for custom, built-in installations. Using the Wilton is an excellent way to convert a piece of furniture into a components cabinet. For a complete description write for your free copy of JBL Bulletin SB1019.

JAMES B. LANSING SOUND INC., *3249 Casitas Avenue, Los Angeles 39, California*

Free-standing JBL C47 is factory-sanded on four sides so enclosure can be placed either horizontally or vertically. Grille snaps out for convenience of home craftsman who wants to apply his own finish.

Custom-installation version of JBL C47 has snap-on grille that overlaps enclosure 1½" on all four sides to cover gap between enclosure and wall framing or cabinet opening.

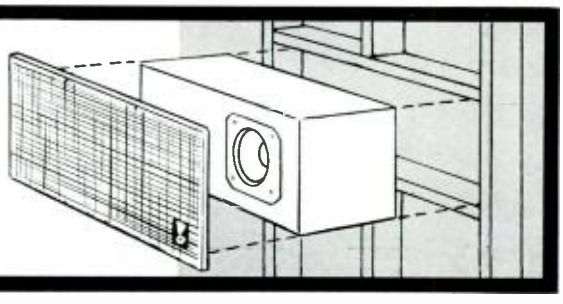


Fig. 5. E.M.I. Stereoscope amplifier. The name comes from the use of a small cathode ray tube as an output indicator.

(dual 20) stereo amplifier *both* for under $200—enough is left over to buy a good phono pickup. Knight Kits are products of Allied Radio Corporation. F-28

E.M.I. STEREOSCOPE PREAMPLIFIER/AMPLIFIER

One of the most provocative small amplifiers we have encountered in months is the recently imported E.M.I. Stereoscope which combines two 15-watt amplifiers and preamplifiers in a more or less conventional fashion, but provides in addition a continual monitor in the form of a cathode-ray oscilloscope which can be used to balance channels, to monitor output level fed to the loudspeakers, to check frequency response (using a test record), and to check turntable rumble.

Each channel of the amplifier employs an EF-86 as a preamplifier—with feedback from plate to grid to effect equalization—half of each of three ECC83's for tone control and voltage amplifier stages, another ECC83 as a paraphase splitter, and two EL84's in the output stage. Another ECC83 is used as an amplifier for the DH3-91 oscilloscope tube, which has a 1-in. screen. Plate power is obtained from a metallic rectifier, and filtering is quite thorough. Both the H. T. supply and the mains—British for B+ and a.c. line respectively—are fused for protection. The unit *is* a British importation.

Front panel controls number a total of 17. Six of these are dual concentrics, used for bass, treble, and level. Separate selector switches are used for each channel, which provides considerably more flexibility than is available with most amplifiers. A master level control operates on both channels simultaneously, and the function switch provides for the usual STEREO, REVERSE, MONO, LEFT, RIGHT, and the unusual MIXING positions. The latter connects both preamplifier-tone control sections to the output amplifiers through 100-k resistors to avoid interaction between the individual channel level controls. The remaining knob controls the a.c. power and the output monitor. The panel is calibrated to indicate the power being fed to the loudspeakers when the trace deviation on the scope is 3/16 in. each side of center, and ranges from a minimum indication of 0.2 watts up to a maximum of 20 watts. The six slide switches control rumble, loudness compensation, and speaker phase, introduce a 60-cps tone for balancing, and control the scratch filters for each channel individually.

Four indicator pilots are mounted along the top of the panel. The two at the left show the left main amplifier function and the two at the right show the function for the right main amplifier. Green lights indicate that the left preamplifier section is connected and red lights indicate the right section. All the indicator lights are controlled by the function switch.

The amplifier is quite compact, measuring 4 in. high, 14 in. wide, and 13¾ in. deep. The front panel is matte gold with chrome trim and black lettering; knobs are gold anodized aluminum, and the outside case is semi-matte black. Ventilation grilles are provided in both top and bottom, and the chrome plated transformer cases give the unit an interesting appearance.

All connections are made to the rear panel. Inputs include tape head, magnetic pickup, crystal or ceramic pickup, two microphone inputs, tuner, and tape amplifier—all being duplicated for both channels. Note the provision for two microphone inputs—only one can be used at a time on each channel, but with the mixing provision the operator can usually manage to switch from MIC 1 to MIC 2 on one channel at a time without too much trouble, unless the amplifier is being used for stereo; then it might be noticeable if a switch were made. Heavy-duty speaker terminals are used, with the impedance selection being made by slide switches, each having two positions: 16 to 32 for higher values of speaker impedance, and 4 to 8 for the lower. Two a.c. receptacles are provided, one switched and the other unswitched, and the a.c. line fuse is also on the rear, as is a heavy ground terminal—desirable with any amplifier.

Performance

Rated power output is 20 peak watts per channel, which is apparently a British designation. By IHFM Standards, the output power measured slightly over 17 watts on each channel at 1 per cent distortion at 1000 cps. Channel crosstalk measured 46 db at 1000 cps, 34 db at 10,000. Tone controls provided ±15 db ranges on both bass and treble. Loudness compensation was moderate, being somewhat less than usual in U. S. amplifiers, but providing a fair amount of compensation in the low-frequency end only, which is in accordance with the Fletcher-Munson curves.

For those who have need for a variety of record characteristics, this unit is especially desirable, since not only the RIAA curve but the old LP and the 78 curves are available. For monophonic use one could have two separate pickups connected if desired. Subjectively the unit would be considered satisfactory by most listeners, and its neat appearance and its flexibility will fill the requirements of many who are not completely accommodated by the usual U. S. design. The 'scope is an interesting feature, and really shows what each channel is doing better than meters. F-29

Fig. 6. Pickering Model 380 Stereo Fluxvalve.

PICKERING MODEL 380 "COLLECTOR SERIES" CARTRIDGE

For almost thirteen years we have had Pickering cartridges of various models, starting with the first magnetic cartridge to appear on the market in 1947—ours was serial number 13, and it was the first one out of the factory—and progressing through the 220, 240, and 260 series to the first Fluxvalve, the 370, and thence to the stereo 371 and now to the 380. The only one we have not used at some time or another is the 194 Unipoise arm/cartridge combination. Each of these units has, during its most popular period, enjoyed the reputation of being one of the best pickup cartridges available—in fact, so much so that it has become more and more difficult to make "improvements" over each preceding model. With the advent of stereo the problem of designing pickup cartridges increased many fold. Stylus velocities are lower, which increases the hum problem; compliance must be provided in both horizontal and vertical planes, and they should be as nearly alike as possible; the axes of the pickup elements must be *exactly* 90 deg. apart to keep crosstalk low, and coil structures must have a minimum of coupling for the same reason, and so on.

There are at present so many excellent cartridges on the market that we have refrained from reviewing them to a large extent. On average program material it is often difficult to tell one from another. Some of the basic characteristics of the Pickering 380 may be of interest, however, without introducing any subjective elements into the description.

The Pickering 380 series—there are two types, one for record changer use and the other for turntable installations—employs a moving-magnet element which is housed in the removable "V-Guard" nosepiece, seen in *Fig.* 6. The small tubular shield for the moving element fits snugly into the cartridge body, permitting a complete shielding of the coils and pole pieces, which are jig-positioned and encapsulated to ensure accurate repeatability of characteristics. The "V-Guard" is positioned accurately by a notch in the body, but may be pulled out slightly and rotated 90 or 180 deg. for protection when not actually in use. Four output terminals are provided, with the external shield being grounded to one of the "common" terminals.

The 380-A is designed for turntable use and will track in the range from 2 to 5 grams, with the lower figure being ideal if the arm will work properly at such a low force. The 380-C is designed for changer use where stylus force falls within the range of 3 to 7 grams. The tips are interchangeable, and the only difference is in the "V-Guard" assembly—the "A" type having greater compliance. We tested only

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24 WATTS STEREO TUNER-AMPLIFIER

SM-B200

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The PIONEER Stereo Model SM-B200, which single-handedly enables superb stereophonic reproduction of broadcast as well as record music, consists of self-contained AM/FM-tuner, AM-tuner, transistorized equalizer, audio-control and 24 watts power-amplifier units and is designed and manufactured in such a way as to reproduce without distortion any sound audible to human ear.

The underside of the chassis is more complicated than that of a black-and-white television set, innumerable parts being rationally arranged. Latest innovations in circuit designs and control mechanisms such as stereo-presence control, knobs capable of either single—or ganged-action adjustments, etc. are generously incorporated in this set.

FEATURES:

1. By means of MW/FM and MW/SW tuners, simultaneous monophonic and stereophonic receptions of broadcast are possible.
2. The set is adopted to any type of pickups—from low-output magnetic to high-output crystal.
3. Through adoption of an equalizer circuit using transistors, hums which are offensive to the ear are completely banished.
4. Tone quality and volume of both right and left channels can be conveniently adjusted either simultaneously or separately as occasion demands by means of knobs of novel design.
5. Stereo effect can be increased or decreased at will.
6. Outputs for a center channel amplifier and a third speaker are provided for stereophonic reproduction with 3 speakers.
7. FM Multiplex stereo reproduction can be enjoyed by connecting an adopter to "Multiplex" terminal post.

MAIN SPECIFICATIONS

Tubes	:	15 tubes, 4 transistors and 4 diodes
Power Output	:	24 watts (12 watts per channel)
Sensitivity	:	AM....30 microvolts for 20 db quieting
		FM.... 2 microvolts for 20 db quieting
Tuning Range	:	No. 1 MW....535—1,605 kilocycles
		SW .... 3.8—12 megacycles
		No. 2 MW....535—1,605 kilocycles
		FM .... 80—108 megacycles
Inputs	:	MAG (Low), MAG (High), MIC, CRYSTAL, AUX
Outputs	:	Dual 4, 8 and 16 ohms, 8—16 ohms for 3rd speaker, For center channel amplifier, For FM multiplex adaptor
Dimensions	:	16⅛"(W) x 5½"(H) x 11⅞"(D)

FUKUIN ELECTRIC, LIMITED

5 Otowacho 6-chome, Bunkyoku, Tokyo, Japan

the "A" type, and found the output signal to be 10.5 mv for a stylus velocity of 5 cm/sec at 1000 cps. With a 47,000-ohm load, response was flat ± 2 db, on a velocity basis from 30 to 15,000 cps, using RCA Test and Technical records 12-5-71 and 12-5-73. Whereas the 371 series had a slight rise in the vicinity of 12,000 cps, the 380 tends to droop above 10,000, and is down about 2 db at 15,000. Channel separation measured 32 db at 1000 cps and 24 db at 10,000 using the same records.

For a subjective description of the 380, we respectfully refer readers to AUDIO ETC for March, 1960, wherein Mr. Canby presents his opinions. We can add to his remarks that there is no stridency audible in the higher frequencies and there do not appear to be any resonances or harsh tones no matter what kind of recorded material is being played. F-30

LETTERS

(from page 6)

The second error occurred in the description of the "A" network used for hum and noise measurements. The network as described would have an insertion loss of 6 db at high frequencies and would roll off at 6 db per octave below 270 cps, the 3-db point. (*We think the 3-db point of the suggested network would appear at 540 cps.* ED.) This is not an "A" network.

The "A" network, as per ASA standard Z24.3–1944, has an insertion loss of 0 db at 1000 and 5000 cps, and shows a gain of as much as 2 db between these frequencies. Below 1000 cps it shows a considerable insertion loss, approaching a 12-db-per-octave slope at very low audio frequencies. For example, at 20 cps its loss should be almost 40 db. At very high frequencies its loss should increase at approximately 6 db per octave. A physical network would therefore have to contain at least three capacitors

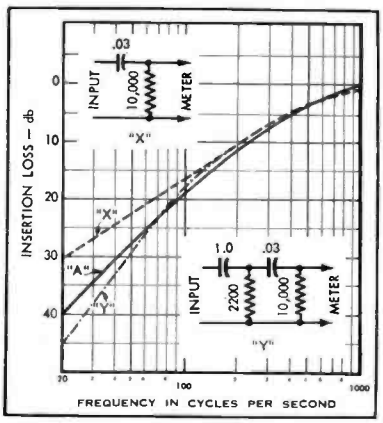


Fig. 1.

along with a number of resistors and would always show an insertion loss which would have to be used as a db correction factor. In my experience of designing such networks for sound level meters I found that such a network would have to have an insertion loss of approximately 15 db at 1000 cps to comply with the tolerances prescribed in the ASA Standard with a reasonable safety margin for component tolerances.

DANIEL VON RECKLINGHAUSEN,
Chief Engineer,
H. H. Scott, Inc.,
111 Powder Mill Road,
Maynard, Mass.

(*Mr. von Recklinghausen is correct as*

to the MPO rating of the amplifier, as specified by the IHFM Standards, and we appreciate his calling this to our attention. However, since the method of measurement specified by the Standard calls for maintaining the supply voltage while making the distortion measurement, it must be admitted that an amplifier with extremely poor regulation would measure just as well as one with perfect regulation, although it would probably not sound as good. We were incorrect in using the IHFM-defined "music-power output" *in our statements about large storage capacitor and low supply resistance.*

As to the second point, we agree that our suggested simple network, shown at "X" in Fig. *1, is off at the low end, but it was only claimed to "approximate" the ASA "A" network. It is actually off 5 db at 60 cps, as shown in the curves. The addition of a second RC network as in "Y" would make the curve more closely approximate the "A" network, being within ±3 db from 1000 cps down to 30 cps. We do not agree that the originally suggested network "X" would have 6 db insertion loss at 1000 cps, but that it would be nearer to 1 db, and it would rise 1 db above 1000 cps. For measurements of hum, we can't see what difference the network would make above 1000 cps anyway. For noise measurements—particularly hiss—the rolloff above 5000 cps could be achieved by shunting a .002-μf capacitor across the output of the "Y" network.* Figure *1 shows the ASA "A" network below 1000 cps, together with the responses of our previously suggested "X" network and that of the modification to the "Y" network.* ED.)

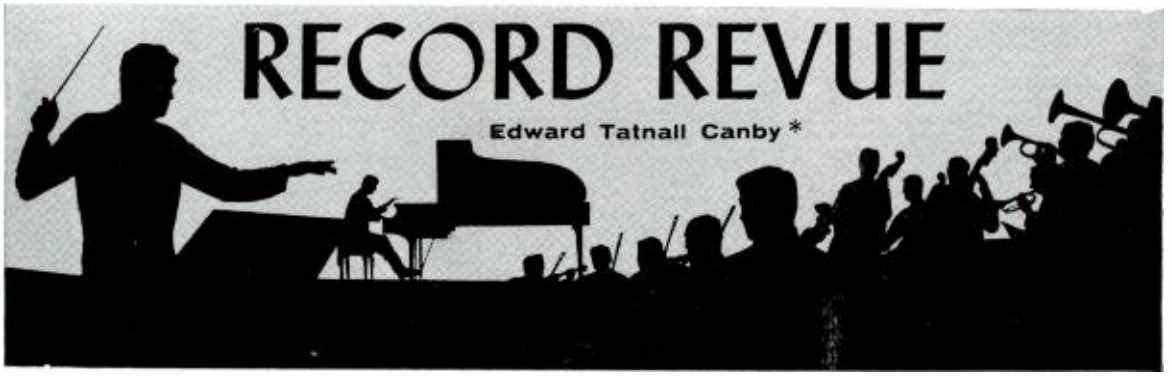
NEW LITERATURE

• **Lafayette Radio,** Dept. P.R., 165-08 Liberty Ave., Jamaica 33, N. Y., has available the second printing of its 308-page 1960 electronics catalog. This second printing is particularly significant in that the first printing had represented the largest ever in Lafayette's 39-year history. It is now expected that there will be enough catalogs to meet every request until the 1961 catalog is published next Fall. Your copy will be mailed free upon written request. **F-10**

• **Duotone Company,** Keyport, N. J., is currently offering its dealers for free distribution to customers a booklet titled, "How?" The four "hows" covered by the publication are: "How to buy a diamond needle?" "How to know when a needle is worn?" "How to identify the needle presently in the record player?" "How to replace a worn needle?" A wealth of information is offered both dealers and consumers. **F-11**

• **Alpha Wire Corporation,** 200 Varick St., New York 14, N. Y., includes important engineering data on the new Alphlex tubing line in a new 8-page 2-color catalog. Information consists of dielectric strength, temperature rating, flammability, and military specifications, all in tabulated form for easy reference. In addition to standard items, the catalog presents information on two new products—Teflon extruded tubing, and silicon rubber extruded tubing. **F-12**

• **Robins Industries Corp.,** Flushing 34, N. Y., eases the problem created by lack of replacement-parts and technical-service data in the tape recorder industry with the publication of the Robins M/M Tape recording Head Reference Guide. The 16-page booklet contains cross-reference material, specifications and illustrations on record/playback and erase heads for 2- and 4-track stereo, and 2-track monophonic. It will serve as an indispensable aid to servicemen and dealers who repair, upgrade, or convert existing tape recorders to stereo. The book is priced at 50 cents.



RECORD REVUE

Edward Tatnall Canby*

1. BEETHOVEN

Beethoven: Violin Concerto. Isaac Stern; N.Y. Philharmonic, Bernstein. Columbia MS 6093 stereo

This is a noble try at the most difficult of all violin concertos to project, and there aren't many versions that surpass it. But, nevertheless, I sense a certain lack in it, a falling between stools.

Put it this way. There are two generally successful approaches to this work. One, not so prevalent any more, covers the great, long stretches of the enormous first and second movements by outstanding dramatic virtuosity, the fiddler displaying gorgeous tone, temperament and color for all he is worth. It works, or used to work, to perfection, though perhaps the over-all structure wasn't always crystal clear. This is a fine violin piece, after all, in sheer fiddle terms.

The other and more contemporary approach is that of purity and restraint, the superbly tailored performance that keeps each detail in perfect balance with the great, extended Beethoven architecture, for an over-all impact of classic persuasion.

The ideal recording in this latter vein is to my mind that by Milstein with the Pittsburgh Symphony under Steinberg, unlikely as it may seem. I've never heard a more beautifully done playing. This present set, Stern and Bernstein, aims in the same general direction—no one will challenge Stern as the topmost exponent of this approach to music. Even at the close range of this microphone pickup his playing is unerringly controlled and expressive, in marvelous taste and utterly true in pitch and phrasing. But the team work is something else again. Taken as a whole, the long movements somehow just are not sustained in all their grand line and shape, nor is it easy to say what goes wrong. Somehow, I can't help feeling, the relatively less known William Steinberg has a greater sense of the dramatic shape of this music than has Bernstein, who, I suggest, is always at his weakest in very slow music of great profundity.

What Bernstein needs is a passionate work—whether modern and jittery or classically Romantic. Just try his Mendelssohn, for instance. There he really shines. Not in this coolest of great Beethoven.

Beethoven: Symphony #6 ("Pastoral").
a. L'Orch. de la Suisse Romande, Ansermet. London CS 6160 stereo
b. Philharmonia, Klemperer. Angel S 35711 stereo

The Sixth is forever a problem on records, even more than in concert; its very mood is such that the recorded medium easily breaks down the delicately illusive nature-worship atmosphere that even concert performances have trouble achieving in this loud, harsh world of ours. Comparisons are fascinating, but dangerous—take two Sixths on records and you'll find yourself in for an afternoon of puzzlement.

I don't think either of these two is really an optimum Sixth as per the recorded medium, but both have strong persuasions, though different. Otto Klemperer, who after a stormy late-middle life emerged as one of the old masters of German conducting art, leads his incomparable orchestra in a playing that is so smooth, so meticulously blended, that it is likely to seem dull on first hearing. It is underplayed as to drama, but revealing in detail and almost puritanically exact in tempo and phrasing.

Ansermet, in comparison, seems positively brash in his romantic approach to the dramatic elements in the score, which is surprising for Ansermet, who is no Stokowski. Not that there is an overdone spot anywhere; but, relatively again, this version is brighter, faster, shinier, full of a more immediate excitement throughout. Surely on first hearing most of us would find it the more communicative. Even the pitch is higher and brighter than Klemperer's (assuming, of course, that the difference is actual, not a figment of the tape machines).

But return to Klemperer and you'll find that his version grows less and less dull at each sampling. I'd call it a sort of draw, all in all.

Both recordings display rather conservative stereo, picked up over-all and at some distance. It isn't easy, for instance, to place the first fiddles positively at one side or the other. Just as well—this is how it really sounds in most halls.

Beethoven: Symphony #3 ("Eroica"). NBC Symphony, Toscanini (Broadcast Dec. 6, 1953). RCA Victor LM 2387

Still they keep coming. This was the last of Toscanini's "Eroica" performances—his first was probably in the year 1898, maybe sooner. He did the symphony more than fifty times after his return to the U.S. back in 1926.

It must be noted, as always, that NBC's recording service, in 1953 as for many a year previously, was something to marvel at—in reverse. Never in the history of recording has a more monumental series of performances had a more monumentally terrible treatment! This late recording, already five years into the LP era and tape, is just so-so, with noncommittal high end and that seemingly inevitable weakish bass associated with Toscanini recordings. Presumably it has been doctored to the full extent of present ingenuity; it has a species of liveness in it, but not enough to get the music altogether out of the audible closet in which it was played. Distortion, anyhow, is low and therefore the listening is entirely easy. But for a recording taken down in 1953—broadcast or no—it is a marvel of something-or-other.

I never was one of the late-period Toscanini worshippers. He is for me not a God but simply an outstanding, if somewhat eccentric conductor, rather more heavily promoted than most. But don't think for a moment he was in any way an inferior conductor. Just temperamental and stylistically a bit narrow—Toscanini's Beethoven was basically nineteenth century Italian, like his Verdi, and as such it goes along just fine, at least in this big, sprawling symphony that can use a bit of high tension and streamlining to strengthen its vastly long musical structure.

The usual Toscanini hallmarks are here: the breathlessly fast tempi, the sense of urgency that seldom relaxes, the fleet, brilliant sound, always with a hint of utterly controlled hysteria in it; there are those familiar metallic kettledrums—they sound like reinforced ashcans—the burping horns, playing faster than they're supposed to go (no leisure allowed *them*), the hurried oboes, the supertense strings, the hard, dry brasses. But I did enjoy this "Eroica" no end as will any music lover. It may be Italianate, clean out of the German tradition, it may lack dignity and weight, but it flows—and compared to the vast run of just ordinarily competent symphony recordings these days, it plays with a freshness and life that are decidedly the real thing.

The Gieseking Heritage: Beethoven Piano Sonatas, Nos. 1, 8, 12, 19, 20, 15 (in part). Angel 3600 B/L (2)

When the great Gieseking died suddenly, he was in the midst of this Beethoven recording project and numerous records had already appeared. This is all of what remained to be released, one sonata left unfinished. As can be noticed, he was working on the less well known early and middle sonatas and his performances of these are perhaps even more valuable than those of this big-selling regulars.

He was at his best, this German, in his peculiarly wonderful playing of French music, where the German didacticism in him let go marvelously, the pianistic know-how remained absolutely tops. He was born in France and lived there awhile—this could be a main clue to his later inclinations, so unusual in any German.

His German music tends to be polished and outwardly on the dry side. His Mozart and Schubert seems furthest in this direction and many listeners don't at all like it. The Beethoven is razor-keen, underplayed on the surface, full of the most wonderful sense of balance, phrasing, impeccable detailwork. For students of these sonatas—players or listeners—Gieseking is beyond compare.

The recording is perfectly suited to the playing; it is done close-up with very little outside liveness, almost an "absolute" recording, yet the piano tone is utterly easy and natural, given a non-Steinway instrument, less brilliant than our usual American piano. This type of recording takes on the color of any room in which it is played. You can have Gieseking in your living room with unusual realism, even without stereo's help.

Beethoven: "Kreutzer" and "Spring" Sonatas (Op. 47, Op. 24). Henryk Szeryng, violin, Artur Rubinstein, piano. RCA Victor LSC 2377 stereo

For years I've tended to discount Rubinstein as a hard-skinned veteran pianistic showoff, yet each time I have heard his recordings of the last few years I have been impressed.

Has he reached a newer and mellower maturity, a deeper sense of musical understanding, after his years of high-powered trouping? It seems so, and his choice of music for late recordings suggests a concern for higher values; he can afford to make records of less "popular" music, after all, at this stage in an enormously successful recording career.

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

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AFLP 1912/AFSD 5912

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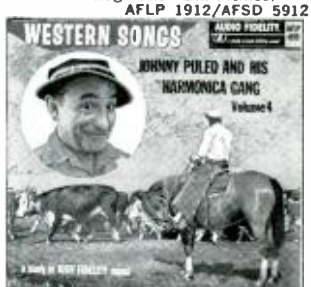
AFLP 1913/AFSD 5913



Go west with **JOHNNY PULEO** and his Harmonica Gang while they play "Red River Valley", "Yellow Rose of Texas", and "On Top of Old Smokey", etc.
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AFLP 1930/AFSD 5930

Hear the rich, resonant voice of **ARTHUR TRACY . . . THE STREET SINGER** singing Marta, the song he made so famous. Hear also in brilliant high fidelity, renditions of "September Song", "Because", "You Are My Heart's Delight", "You'll Never Walk Alone", and "Beautiful Love".
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- **EDDIE JACKSON** . . . the struttin' vaudevillian singing "Waitin' for the Robert E. Lee", "Bill Bailey", and "Sweet Georgia Brown".
AFLP 1909/AFSD 5909

- Outstanding artistry . . . unequalled virtuosity . . . **LARRY ADLER** . . . playing "There's a Boat Leaving", "Genevieve", and "Summer Time".
AFLP 1916/AFSD 5916

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This Beethoven disc is subtly impressive, for it is the pianist who has the big name, where in many a recording the fiddler leads, or is equally a drawing card. The normal microphone bias is towards too much fiddle—here, thanks to the magnetism of Rubinstein, RCA is drawn to a very nearly ideal musical balance in the microphoning. (So I imagine it, anyhow, in my world-weary way.) And the two musicians, out of a similar background, hit it off beautifully. This is taut, expressive Beethoven but it is perfectly controlled—as the "Kreutzer" often is not in its many tempestuous moments. (Some readers will remember the Busch-Serkin performances of this music!) Perhaps the most revealing parts are those which are lyric and simple—the Rubinstein-Szeryng team is superb there, notably in the absolutely lovely second movement variations. Play these and you will never again have the heart to criticize Rubinstein for hard-boiled playing.

Beethoven: Sonatas for Violin and Piano Op. 47 ("Kreutzer"), Op. 12, No. 1. Zino Francescatti, violin, Robert Casadesus, piano. **Columbia MS 6125 stereo**

In its current Casadesus festival Columbia here parallels RCA's "Kreutzer" Sonata, with the two French players opposed to the new Rubinstein-Szeryng team. It's a fine recording in many ways, but I'd take RCA Victor's "Kreutzer" any day.

I should qualify this immediately by suggesting that part of the difference is simply in the French outlook upon Beethoven, which is often inexplicable to those beyond the circle of French musicianship. The "Kreutzer" variations, on RCA so affectingly, serenely beautiful, are, on Columbia—or seems, at least—brittle, superficial, too fast, without pathos. The very essence of Beethoven, the contrast between stormy violence and eloquent meditation, seems wholly absent. If it were not that so many other French performances display the very same quality, one might condemn this Casadesus-Francescatti playing outright.

Nevertheless, I can't help feeling that the French team plays on a plane of less musical profundity than the Rubinstein-Szeryng duo. Francescatti is a man of fabulous polish and sweetness of violin technique, but he is not exactly passionate in the German manner. Casadesus is a pianist who, like Dorati, the conductor, leaves me always with a curious sense of unmusicality, hard to explain but very, very positive. I'm not enthusiastic about their combined Beethoven, though it is surely of a high professional order.

Beethoven: Piano Sonatas in F Minor Op. 57 ("Appassionata"), D, Op. 10 No. 3. Vlodimir Horowitz. **RCA Victor LSC 2366 stereo**

Yes, he's a great pianist, but no pianist alive can play *everything*—or should. This one should stay clear of Beethoven. RCA can safely leave that to its other bigshot name, Rubinstein, who plays Beethoven very nicely.

Perhaps it would be better to say that though the Horowitz Beethoven pleases Horowitz and is the result of typically hard study (note the A flat from the Beethoven ms. replacing the printed F, as described in the notes), though anything Horowitz does has flair, architecture of its own sort, musicianship, drama, his Beethoven is too far from the ordinarily acceptable traditions to please most listeners who know the music reasonably well. Lots of people will take it on its own merits—as a sort of classic-Russian Beethoven, slightly out of Rachmaninoff. Others—plenty—will buy this record merely because it is played by Horowitz, the son-in-law of Toscanini.

2. THE PROFESSIONAL TOUCH

Diverse Winds. (Persichetti; Symphony for Band. Grainger: Hill-Song #2. Hartley: Concerto for 23 Winds. Khachaturian: Armenian Dances.) Eastman Wind Ensemble, Fennell.

Mercury SR 90221 stereo

This enormously competent wind ensemble has a whole series of wind recordings in the catalogue, probably thanks to the consuming interest in wind music all over the country among school, college and community performers as well as professionals. No doubt at all, the playing of this band is technically fantastic. Such perfection of ensemble has rarely been achieved anywhere, and the wind playing public is absolutely right if it buys up these records as fast as they come forth.

But for the likes of the rest of us—I'm not so sure. Nothing succeeds like polished professionalism these days. I've found a lot of the music these people play to be of more technical than musical interest, on a high plane within the wind-playing world but not necessarily elsewhere; I've felt that their playing of popular wind music, too, is on the academic side, even a bit prim; Leroy Anderson, for example: there's an amazing lack of spontaneity and verve in their dry, didactic Andersoniana (SR 90043 and 90043). Their band marches are of a similar type, superbly well played technically but somehow dry, hard.

I liked the Walter Hartley Concerto for 23 Winds, on this record, which though ostensibly a product of intra-Eastman training seems to have a whale of a lot of Hindemith in it and not a little of mid-period Stravinsky. A thoroughly musical modern piece, as well as a technical tour de force for winds, and it wants only a bit more stylistic self-possession.

The Persichetti, its author far more illustrious, rubbed me violently the wrong way, though it is not easy to say why in explanatory words. It is of a school that seems to me blatantly unmusical in a strong-minded and technically proficient way; old-fashioned rules of harmony and counterpoint are broken loudly, deliberately flouted, but nothing newly expressive is built in their place (for my ear), only sheer unmusical ugliness raised to an incredible pitch of technical know-how. These are hard words and they are my first reaction—maybe you'd better give Persichetti a chance via your own ears.

The Grainger and Khachaturian items are fillers of shorter duration, the first a surprisingly modern and richly scored bit of neo-English complexity from the famed composer and friend of Delius, the second a sort of modified Gayne music in familiar idiom.

Bach: Jesus, Dearest Master (Jesu, meine Freude); Christ Lay in the Bonds of Death (Christ lag in Totesbanden). RCA Victor Orch., Robert Shaw Chorale, Shaw.

RCA Victor LSC 2273 stereo

What Bach has needed for a long time, it must be admitted, is a competent and accurate performance style for the famous cantatas and motets, done with approximately the right-sized forces. Innumerable worthy versions in the past have either boasted enormous numbers of performers, or have expended much zeal at the expense of accuracy.

Robert Shaw has fixed all that. His professional singers and players are entirely competent, singing even the most turgidly constructed passages of these muscular works with never a note out of place, not a trace of confusion. That in itself is a lot.

But where is the soul? It is here, perhaps, in suave understatement—in luxurious tones, voices richly colored, if lacking in diction, strings that play carefully and rightly. Or is it? Take the ancient RCA recording of the pre-war Orfeo Catalan, with large, unauthentic orchestra, screetching boys' voices (now probably long since dead in the Revolution), full of rank sentimentality. Even so, it will make your hair stand on end if you love Bach. Robert Shaw's well bred, beautifully groomed voices are lovely in themselves; but how, I ask you, can you put over the raw, flaming musical and religious feeling in Bach's superb writing via such a polished and perfected

presentation? Nobody wants wrong notes and sloppiness—Heaven forbid that, as an end in itself! But somehow, the human slips of a passionate performance have more enduring conviction than the more perfectly trained tones of such as these well-routined Shaw singers.

And yet I enjoyed every bit of this recording, even so. And it was pleasant, here, to find the motet (Jesu, meine Freude) sung with sustaining instrumental accompaniment, putting aside the false tradition of singing the Bach motets unaccompanied, as Bach never intended.

Brahms: Clarinet Sonata #2, Op. 120; Clarinet Trio, Op. 114. Gino Cioffi, clar., Samuel Mayes, cello, Ralph Berkowitz, piano. **Boston B-214**

Here are two of the loveliest of late-Brahms chamber works, featuring the high color of the clarinet and featuring, too, the big, solid recorded sound that Boston has developed for its small but impressive chamber catalogue. The playing is, however, of a mixed sort, professionally praise worthy but not precisely impassioned. Only the cellist, Samuel Mayes, seems to me to play with soulfulness as well as high competence; the others do a splendid job, but an outward one.

The pianist, Berkowitz, is a musical administrator (Berkshire Music Center, Albuquerque Civic Symphony) and plays Brahms with a sort of administrative dash, like a good executive-executant. Cioffi, Italian clarinetist of Boston, plays one of those reserved, almost chaste clarinets; the recording picks up an unusually wiry and nasal tone color.

We can't have soul-passion in every performance and we scarcely need it. You'll find these clarinet works healthily pleasurable in this extrovert form.

Milhaud: The Four Seasons. Ens. de Solistes des Concerts Lamoureux, Milhaud. **Epic BC 1069 stereo**

It was old Saint-Saëns who produced music the way a fruit tree produces fruit—the analogy was his own and his output was prodigious without a doubt. Milhaud seems to be his successor, though Saint-Saens was bony and Milhaud is fat. Milhaud's music is more like watermelons, the little tart, juicy ones. He just produces and produces, always in good taste, his fruits well shaped and pleasing to the musical ear, turned out in loads. The water content is fairly high, the melons are too much alike, but every one of them is worth trying.

These are brief, snappy little concertinos for odd groupings of instruments, composed over a quarter-century, almost, though you wouldn't know it in the listening. Summer is for nine instruments and solo viola, Autumn features two pianos; Winter flaunts a solo trombone, of all things, against strings; Spring is heralded with a violin solo. Nice hi-fi and good, crackling, pleasant modern styling. But all four at one dose will leave you yawning.

Chopin Waltzes (complete). Moura Lympany, piano. **Capitol SG 7169**

Electrical-Musical Industries here adds a third set of these waltzes to the recent pair of releases on the Angel label, by Cortot (from before the war) and Malcuzynski. Chopin playing is a delicate matter for criticism and I might be wrong, but of the three this set is for my ear much the least impressive. I like Malcuzynski's broad, unostentatious style, fluent and very expert in the pedaling and harmonic treatment, and like most piano listeners I was fascinated by Cortot—for good and bad. Lympani seems to me relatively colorless, the waltzes played with technical competence but only moderate subtlety, the harmonies often just slightly blurred by the fingers and pedal, as though for lack of sufficiently subtle ear. Not bad—just not really excellent.

Ravel: Gaspard de la Nuit; Le Tombeau de Couperin. Charles Rosen, piano. **Epic LC 3589**

Here's another one of those hard-to-put-in-words critical problems, a pianist of great proficency, playing one work of quiet subtlety and another of fiendish difficulty, who seems to me wholly to miss the "point" of Ravel's music, in ways both stylistic and purely musical. I couldn't prove it—nobody could. Mr. Rosen could as easily say I'm wrong. Even so, I have to report that I missed much of the meaning of one of my favorite composers in this handsomely forthright recital; I just don't feel that he hears what he is playing, neither the razor-sharp elegance of the Ravel manner, the piercingly lovely melodies, the sensitively violent outbursts of passion, nor—most of all—those marvelous harmonies in compound ninths and elevenths and thirteenths. It's all harmonically dun-colored here. It's all sincerity and hard work, not to no avail, but to the wrong one. Not even the rhythm is good.

Mr. Rosen even writes his own program notes, to great lengths and considerable interest. I find myself almost wishing him outloud towards a better realization; it's hard to think that so much good work should go towards a less than perfect result. But then, maybe other critics will hear him differently. I practically hope so.

Stravinsky: Le Sacre du Printemps. Minneapolis Symphony, Dorati. **Mercury SR 90253 stereo**

Stravinsky: Petrouchka. Minneapolis Symphony, Dorati. **Mercuy SR 90216 stereo**

These handsome mint-green-and-white jackets contain the hi fi man's latest dream of sound perfection, served up in superstereo—but those who know the music may pause and wonder. What is it that this Dorati and, perhaps, these Mercury engineers do to make this music so efficiently cold?

I heard a story recently, of the man who invited five hi fi enthusiasts and five musicians to his home and gave them the old blind-ear test on Dorati versus, I think, Ansermet. It was "Le Sacre" most likely. You can guess: the five hi fi men picked Dorati to a man, the

musicians went for Ansermet. I won't vouch for the truth of that tale but it points the strange paradox in this Dorati music, which is played so expertly, with such professional discipline and accuracy of ensemble, that the questioning musical ear is left in perplexity; *why isn't it better music?*

I keep saying to myself that it's bad phrasing, lack of musical line, rigid tempi, no sense of melodic and harmonic climax . . . but these are terms of technical jargon. You can't explain. You just hear, or you don't.

In any case, the Mercury stereo technique is undoubtedly striking—an almost disembodied close-up effect as though the whole orchestra were oddly confined within a gravity-less space, unreverberant yet not dead, the instruments suspended somehow at an equally short distance. There is virtually no sense of the imaginative concert hall; but the strangely ultra-clear detail work of the orchestra is fascinating, and perhaps recompense enough. Mercury's hi fi stereo sound is so refined that it is sweet and lovely even in the loudest powerhouse sections.

Dvorak: Slavonic Dances, Opp. 46, 72. Smetana: Excerpts from "The Bartered Bride." Minneapolis Symphony, Dorati.
Mercury SR2 9007 (2) stereo

Brahms: Symphony #2. Minneapolis Symphony, Dorati.
Mercury SR 90171 stereo

Here are two standard-classic recordings by Dorati and they are not unlike the Stravinsky records in effect, limpidly pure hi-fi, quite without distortion, an oddly spaceless, ultra-violet sort of mike pickup and performance that are all cold polish, sometimes hard, sometimes merely inexpressive, in ways that are not at all easy to pinpoint.

The Dvorak dances are gay, forceful and pounding, as chilly as Dvorak himself is warm. The Bartered Bride music is lined out with the neatness of machinery in action—the beat pounds, your feet tap, the music unreels with perfect decorum and soullessness, clean and glittering.

As for Brahms, Dorati doesn't ever make the classic mistake of more florid conductors, over-tearing of hair. The notes are wonderfully accurate and the orchestral texture under the Mercury treatment is ever so clear, a study in detail such as is rarely heard on records. The symphony for the most part is cool, mild, somewhat pale and well mannered; but towards the end, when Brahms puts on steam, it tightens up to a chilly frenzy. Everything is in its place, including the impression of great zeal—but the music remains lifeless, to my ears.

Phrasing, shaping, balance—how can it be explained? I wish I could put it in words, yet, after all, words are not what count. Better the poetic phrase "it has no soul" than an even less satisfactory technical analysis. I'll have to leave it at that . . . but remind you that the fi is *very* hi, soul or no.

3. MIXED NATIONALITIES

Stravinsky: Petrouchka. Boston Symphony, Monteux.
RCA Victor LSC 2376 stereo

Superb, extraordinary! Maybe some details of this measured and leisurely but utterly dynamic "Petrouchka" may surprise you, for it is quite unlike any other. But if you wish to hear a real conductorial master at work (with a batch of genius musicians and recording geniuses to help), then study this closely.

First, Monteux is a supremely great musician of the sort who shapes his music architecturally to the last detail with such naturalness, such utter simplicity, that you can only marvel at the new subtleties which appear everywhere. He is a man for the solidly buttressed background—his supporting cast, so to speak, is always superb—thousands of fascinating details normally swept under the grand musical rug are here brightened up and set each in its place to add dynamic life to the whole. Absolutely fascinating.

Second, Monteux is a great humanist, in an age of zombies. You've seen his jolly

(*Continued on page 71*)

CHARLES A. ROBERTSON*

STEREO

Benny Carter: Helen Humes
Contemporary S7571
Count Basie: Dance Along With Basie
Roulette SR52036

Vocalist from 1938 to 1941 with the Basie band during its early peak period, Helen Humes later settled in Los Angeles and her subsequent career proved somewhat of an anti-climax until she chanced to make this album—the first under her own name. For once, she enjoys complete freedom in the studio and quite handily surpasses any of her previous efforts. Although such talented arrangers as Benny Carter and Andre Previn take part, they are present as improvisors only and their ideas spring to life unaided by the pen. The singer is in command from the start and draws fully on her long experience to sail blithely through ballads, blues and rhythm tunes.

Not only does Miss Humes avoid dealing with an arranger's preconceived notion of how she should sound, but most of her tunes are selected on the spur of the moment. This, plus the fact that her voice can be treated as another instrument, is enough to keep the accompanying sextet creatively alert and swinging. Acting as nominal leader, Carter limits his playing to trumpet alone, supplying vibrant introductions which are, as always, the epitome of good taste. To bring out the full flavor of the blues on *Trouble In Mind*, his muted backgrounds are more highly seasoned.

With pianists like Basie, Teddy Wilson, and Earl Hines looking over his shoulders, Previn might seem out of his element. As no screen credits are involved, he contents himself with terse rhythmic comments, working up considerable enthusiasm on the *Saints*. Even Frank Rosolino, whose natural ebullience often causes him to ignore his surroundings, is affected enough to take a tender trombone solo on *Stardust*. Teddy Edwards, a tenor player who might have been schooled by Basie, fits in admirably, while Leroy Vinnegar is on bass, and Mel Lewis and Shelly Manne alternate on drums. They need little urging from Carter to provide an accompaniment which rates among the best a vocalist has received in jazz annals.

But credit for lifting the set above the comeback level belongs wholly to Miss Humes. Admirers of her work with Basie, knowing that she held the post longer than any singer of her sex, may well question the validity of a statement regarding her present superiority. Perhaps they will be convinced by the ease of her phrasing on *You Can Depend On Me* and *A Good Man Is Hard To Find*. If not, they should find the trick being turned by the maturity of her emotion on *Among My Souvenirs*, *Bill*, and *When I Grow Too Old To Dream*. They may also remember that her appearances with Basie were often overshadowed by the intensity of the band and the stature of the soloists. As framed today in the best of stereo, her voice carries great assurance and makes an immediate impact on both listener and supporting group.

Meanwhile, the Count turns in a workmanlike dance set, adopting tempos suitable to a businessman's bounce or a debutante's swoon on ten standards. Designed to permit paying customers at the Waldorf-Astoria and other luxury hotels to expend a minimum of effort while moving around the ballroom, the program will undoubtedly prove equally restful to anyone attending a stereo dance party. Unlike Duke Ellington, who is able to take the commercial aspects of the business in a jovial stride, Basie becomes deadly serious when forced to let the jazz level drop. Only Al Grey escapes his restraining eye and spreads trombone smears riotously over the last chorus on *Makin' Whoopee*. One barometer of Basie's opinion of his work is the way he chortles with glee as the band romps through a blues piece. If he smiled once during this outing, it was better than par for the course.

Basie has never shown much tolerance for girl singers in the band, usually hiring one only at the insistence of his managers. He once expressed his attitude with the comment that Helen Humes "handled the vocals the way we all felt they could best be handled." At this stage of the game, she is no longer a girl singer and is perfectly capable of handling the vocals in her own way. She stands today at her full stature as an artist, having finally arrived after a long period of striving. She certainly deserves wide exposure, especially at a time when the number of major jazz singers can be counted on the fingers of one hand. Perhaps she could even snap Basie out of the lassitude which descends upon him during a popular number, if given the chance, and win an approving smile. At least, she would be a shining example for his soloists.

Rev. Gatemouth Moore: Revival!
Audio Fidelity AFSD5921
The Caravans: Blessed Assurance
Gospel MG3007 (mono)

These albums are a joint invitation to become acquainted with what Cannonball Adderley means when he talks about "the roots of soul church music," and they represent various aspects of a vital force that is becoming increasingly important in jazz. Reverend Dwight Moore ran away from his home in Topeka, Kansas, to join a carnival at the age of twelve. He remained ten years and picked up the "Gatemouth" nickname during his travels. Later, due to the success of several of his own songs, he gained a reputation as a blues singer. While singing one titled *I Ain't Mad At You, Pretty Baby*, he felt the stronger pull of religion and ran from the Chicago nitery where he was working. After that August night in 1948, he never looked back and now heads the Community Baptist Church in the same city.

Stereo places the listener, tambourine in hand, right behind the pulpit, from which the Reverend leads his congregation in gospel performances similar to those depicted in recent jazz compositions of Charlie Mingus. Unlike most of his contemporaries, Moore still sings the blues, using them to introduce his personal testament, *Glory, Glory*, one of the few numbers where the two styles can be heard side by side. The accompanying group is highly blues resistant, however, and reacts with great fervor when he throws out the challenge of a blues inflection. His experience as an entertainer and composer is also used to produce distinctive versions of *Down by the Riverside*, and *By and By*.

The Caravans also hail from Chicago, appear in churches and theaters throughout the country, but are recent arrivals on LP. With their second release, it becomes apparent that the four female voices comprise a remarkable and original singing group, one which combines all the gospel elements now being copied by both jazz and popular performers. Unfortunately, the soloists are not identified on the liner, nor is the leader, Albertina Walker, given credit for her work as a composer. Perhaps this oversight will be corrected, once the quartet begins to get the attention it deserves, and a proper stereo recording may result. Right now, you can be sure that informed composers and musicians are subjecting the group's singles and LP's to careful analysis. Statements that such artists as Horace Silver, Bobby Timmons, and Milt Jackson are influenced by the pseudo-gospelizing of Ray Charles hardly seem plausible, especially when, as these albums demonstrate, the real thing is so readily at hand.

Al Hirt: Swingin' Dixie
Audio Fidelity AFSD5926
Dick Cary: Here Come The Dixieland Doodlers
Columbia CS8222

Designed to keep a Saturday night party from dying on its feet, this pair of LP's will also chase away morning gloom and start the day off to a dixieland beat. Al Hirt, in fact, held just such a job in New Orleans, waking up the city with the Dawnbusters Orchestra on a six-days-a-week radio program. His trumpet is usually trained at Bourbon Street revelers today, but its tones are no less effective. Based on a frank admiration of Ziggy Elman during the Benny Goodman heyday, his style carries overtones characteristic of early Roy Eldridge that are worthy of further development. Most of the men who started out in this brash fashion are now engaged in studio work or, like Louis Prima, are entertainers first, so Hirt is one of the few now playing for regular paying customers. He keeps them satisfied with the fast shuffle of a riverboat gambler, stacking *Sweet Georgia Brown*, with a flash of dixieland hokum, right on top of a hole card such as *Up A Lazy River*. To add to the deception, he extracts from one sleeve, *Lullaby Of Birdland*, and from the other, *Down By The Riverside*. Quite a trick, and very startling in stereo.

Dick Cary orders eight Dixieland Doodlers into parade formation and leads them through a dozen neatly turned tunes. No one misses a step, as an unwavering tuba and Lee Blair's banjo augment the rythm section, and dancers will tread with equal assurance. Cary wields a trumpet this time and his arrangements follow a direct, melodic route on *Waltzing Matilda*, *Camptown Races*, and *Tavern In The Town*. With Kenny Davern, clarinet, and DiVito, trombone, on either flank, the squad wheels smartly by in stereo array. Both sets list *Mack The Knife*, which is becoming almost as inevitable as *The Saints*.

The Great Wide World of Quincy Jones
Mercury SR60221
Patti Brown Plays Big Piano!
Columbia CS8208

The opportunity to hear a new pianist work out with a big band is pretty rare nowadays, largely due to the number of leaders who hold that position themselves. And unless the pianist is the boss, he seldom gets a chance to be heard anyway. So when Quincy Jones hires a pianist who turns out to be a girl and is actually given solo passages, it becomes something of an event. Seattle, the leader's own hometown, was the birthplace of his protege, and Patti Brown began playing by ear before she was three years old, having been born the same year Mary Lou Williams started the Andy Kirk swinging back in 1931.

Even the launching of a big band today is enough of an event to warrant the continued interest of enthusiasts during the shakedown cruises. Jones, who found time to try out his own ideas on the first, allots the second entirely to other arrangers, testing serviceable fittings by Ernie Wilkins, Bill Potts, and Al

* *732 The Parkway, Mamaroneck N.Y.*

Cohn. On the heels of Gil Evans' setting of *Chant Of The Weed*, an effort by Ralph Burns seems puny. Although some changes in personnel are noted, the band still is not identical with the one which Jones is currently employing on a European tour. It attains a fine cohesion of sound, however, and featured soloists included Jerome Richardson, Budd Johnson, Phil Woods, and Jimmy Cleveland. Bob Fine's choice of microphones and their placement in stereo is detailed on the liner.

Patti Brown's sound is aptly described by the title of the first album released under her name. On the basis of her performance on three LP's, it is no figment of electronics and should be adequate to overcome the various deficiencies of public address systems encountered on tour. Her own original blues and gospel-based works are glowing demonstrations of this aspect of her style, and Jones would be wise to develop several into band specialities which spotlight the pianist at length. After all, girl pianists do help sell a band better than bad vocalists. Aided by bassist Joe Benjamin and Ed Shaughnessy, on drums, she exposes four compositions with the full benefit of stereo. More subtle passages, on *Give Me The Simple Life* and *I Didn't Know What Time It Was*, give the impression that she could become a respectable supper-club pianist. But her heart is obviously with a big band.

Harry Belafonte: Swing That Hammer
RCA Victor LSP2194

If a prison worksong is to be adequately realized in a recorded performance, spacious surroundings are a necessity. The tempos originated with the muscular movements involved in laying railroad track, building gravel roads, and chopping cotton. When the natural flow of rhythm is altered to suit a concert performer's ideas of phrasing, the songs suffer the consequences. Harry Belafonte wisely utilizes the entire breadth and depth of the stereo stage to create a proper setting for each song—be it the broiling sun of *Look Over Yonder*, or the rain-soaked humor of *Talkin' an' Signifying'*. The Belafonte Folk Singers, under the direction of Robert De Cormier, are allowed plenty of room in which to work and send back responses from realistic vantage points. Needless to say, Belafonte is fully capable of stretching each line until the utmost is extracted from it. Bob Simpson is responsible for the excellent Webster Hall recording.

Belafonte is occasionally accused of sweetening folk material. Anyone questioning his authenticity this time can refer to Folkways P475, "Negro Prison Camp Work Songs," recorded in 1951 at Ramsey and Retrieve State Farms, Texas, which also contains *Grizzly Bear, Here Rattler Here*, and *Go Down Old Hannah*. It may be noted that the prisoners, confronted by a microphone and singing indoors, show a tendency to increase tempos as a song progresses. By adding lyrics and heightening dramatic emphasis, Belafonte makes each number an understandable and living experience.

Dinah Shore: Dinah Sings Some Blues With Red **Capitol ST1354**
Rosemary Clooney: A Touch Of Tabasco
RCA Victor LSP2133

An eminent pair of songsters enjoy settings which permit them to relax and warble most melodiously on these albums. Red Norvo's recent appearances on the Dinah Shore show provided a pleasant relief from the chrome-fitted sounds which usually accompany her on the television screen. Ever since he learned to back a vocalist while teamed with Mildred Bailey, the vibraphonist has managed to ad-lib supporting lines more apropos than any arranger can write. Working with a singer who understands his language, he is bound to make sparks fly during bright exchanges. It happened on the Shore show, and the encore offered here consists of swing-era tunes which bring out the best in both participants. They romp gaily through *Bye Bye Blues*, *Who*, *Skylark*, and *Someday Sweetheart*. The Quintet also features Jerry Dodgion, alto sax, and gains breadth in stereo by the addition of a muted trumpet quartet.

Rosemary Clooney finds a match for her ebullient spirits in Perez Prado, whose peppery

Latin rhythms also seem to have impressed spouse José Ferrer. At least, his enthusiastic liner remarks connote approval of the combination. With a singer of this caliber, Prado has no need of freak effects and limits himself to a few satisfied grunts. But he makes sure every tune gets a Latin beat, even *Mack The Knife*. Hollywood's Music Center of the World allows ample stereo spread.

Jimmie Driftwood: The Westward Movement — **RCA Victor LSP2171**
Cathie Taylor: A Little Bit Of Sweetness — **Capitol ST1359**

After following the wilderness road across the Appalachians on his first album, Jimmie Driftwood continues the journey westward, gathering trailmarking songs on the way. His starting point is *The Land Where The Blue Grass Grows*, and includes a visit to *The Widders Of Bowling Green*. With a sharp ear for the vernacular, he alters his accent as he goes along, adopting a sagebrush drawl for *The Marshal Of Silver City*, and *The Pony Express*. Driftwood, aided by a fine stereo recording from Nashville, possesses the knack of making the dust, humor, and hardship of a wagon train come alive. He is a real character and three songs are his own. You almost believe that he was there, along with his guitar.

Cathie Taylor is a sweet-voiced daughter of the pioneers who completed the cross-country trek to California. A 4-H Club contest winner, she makes her recorded debut as a protege of Cliffie Stone, singing both traditional and new songs. Although staking no claims for her authenticity as a folk singer, she does better than many with more pretensions. Before long, she may be performing beside a covered wagon on television. Jack Fascinato's arrangements provide a natural setting and the voice is nicely framed in stereo.

MONO

Joseph Lamb: A Study In Classic Ragtime — **Folkways FG3562**

When Rudi Blesh and Harriet Janis were gathering material for the first historical study of ragtime, they conducted a lengthy search for Joseph Lamb, a composer who was so little a part of the music world that one theory attributed his works to Scott Joplin. He was finally located at his home in Brooklyn and an interview appeared in their book, "They All Played Ragtime," which was published ten years ago and is still the standard reference work on the subject. Now available in a new paperback edition, its fascinating truths should reach a younger and vaster audience. There is irony to be found in the fact that the musical press, in the interim, steadfastly ignored the one remaining great writer of a purely American music. It became worthwhile, however, for Lamb to restore the copyrights on his published compositions and attempt to preserve his newer rags. He also began to play again and was recorded for the first time last summer, in his seventy-second year.

Samuel Charters moved his portable equipment into the Lamb living room at 2229 East 21st Street, near Coney Island, and taped the composer at a Knabe upright over a period of weeks. Lamb believes ragtime should be played as written and practiced hard to make the definitive versions note perfect. While lacking the technical brilliance of such modern practitioners in the idiom as Wally Rose, Ralph Sutton, and Knocky Parker, his playing is always valuable for the composer's viewpoint. In this respect, a curious parallel might be drawn to Thelonious Monk's highly individual style, which often is criticized erroneously on the basis of technique. Would that a few more pianists had this pair's creative ability and rare sense of timing. After hearing Lamb, many listeners will be convinced that Monk knows more about ragtime than anyone has gotten him to admit. And Lamb, if given the benefit of thirty years, would undoubtedly manage a better version of Monk than many of the current imitators.

As it is, only a handful of pianists now exist who can match Lamb on *Excelsior* and *Topliner*, his more difficult pieces. Besides playing *Contentment* and *The Ragtime Nightingale*, he discusses details of their composition and tells how he first met Scott Joplin. In addition to the classics *Sensation*, and *American Beauty*, two recent unpublished rags are included. Charters, assisted by wife Ann, turns in a professional recording job and is to be commended for once again documenting a lively musical era.

Sidney Bechet: Brussels Fair Concert, 1958 — **Columbia CL1410**
Joe Newman: Counting Five In Sweden — **World Pacific WP1288**

Stories American jazzmen tell about the exhilerating effect of playing for European audiences are amply substantiated by these zestful performances. Sidney Bechet, an old hand at such gatherings, enjoyed a reunion with Buck Clayton and Vic Dickenson at the Brussels Fair of 1958 and made his appearance a historic moment. Howard Taubman's dispatch to the New York Times credited the sextet with "a sense of rhythmic momentum and a gusto that is in the liveliest tradition of American jazz." As it turned out to be Bechet's last concert appearance before his death four months later, it is regrettable that Ernest Ansermet was not also among those present to add a footnote to the famous 1918 piece in which the youthful virtuoso was first cited as a genius. But Ansermet must know by now of the accuracy of his prophesy that Bechet's way of playing was "the highway along which the whole world will swing tomorrow." Everything the great soprano saxophonist did that evening was a fitting climax to a distinguished career. Bechet shared with Louis Armstrong the ability to transform time-battered tunes into moving experience, in this case *Swanee River*, and to completely dominate a crowded auditorium in the process. Clayton's trumpet is featured on *All of Me*, and Dickenson's trombone on *In A Sentimental Mood*.

Joe Newman devoted two weeks of his vacation from the Basie band that same year to a concert tour of Sweden, heading a sextet of fellow members, with the reliable Nat Pierce along to duplicate the Count's piano parts. Among the stops were Gothenberg and Stockholm, where Gosta Wilhelm recorded the proceedings. Several of the arrangements are from the Basie book, but the ad-lib solos are

agreeably expanded. Frank Wess plays flute in exchanges with drummer Sonny Payne on Neal Hefti's *Cute*, shifting to tenor sax on *Easy Living*. Trombonist Al Grey solos on *September Song*, Newman's open trumpet embellishes *Don't Blame Me*, and Eddie Jones' walking bass underlines *Slats*. The exuberance of the group's playing often matches that of Bechet, something which occurs rarely either in the studio or at concerts in this country. Both sets terminate, incidentally, with rousing versions of *The Saints*.

The Art Tatum Discoveries, Vol. 1
20th-Fox 3029
The Original Chico Hamilton Quintet
World Pacific WP1287

Always a music of discovery, jazz is again unexpectedly enriched by these two additions to the repertory. Ever since Art Tatum attended a party at the home of the musical director of a Hollywood film studio in 1956, his host has cherished tapes of the evening's highlight—an informal solo recital by the pianist lasting nearly two hours. Now, thanks to an arrangement with Mrs. Tatum, the first installment of the pianist at his spontaneous best is released from the confines of a private collection. There are twelve superb instances of Tatum playing in the relaxed manner that won him the respect of musicians before the public called him a genius. Perhaps it was the effort to live up to this designation that made him seem overly busy on his later studio recordings. He shapes melodies to please himself this time, and continues in full stride while lighting an occasional pyrotechnic display for the amazement of his friends on *Yesterdays*, *Tenderly*, and *Someone To Watch Over Me*.

The recording is sharp and very close, picking up the pianist's cherubic chuckle when an especially brilliant rocket bursts on *You Took Advantage Of Me*. Tatum was unaware of the open microphone until after the performance. Fortunately, he approved of the procedure, leaving behind a tape that is now an undying momento of his last year of life.

The original Chico Hamilton Quintet succeeded in titilating a good many jazz listeners and also attracted a following among record buyers who had never paid much attention to jazz before. Due to an admirable debut LP, assembled from concerts at the Strollers Club in Long Beach, California, in the fall of 1955, the group established a nationwide reputation at once. The deferred release of nine performances, recorded at the same location on November 11th of the same year, now permits the first examination of additional prototypes of the group's format. As before, the program is an outstanding example of imagination at work and includes originals by the leader, Fred Katz and Buddy Collette. Once the original group disbanded, later editions never managed to equal its spirit and Hamilton recently announced plans to abandon the chamber jazz policy. So this vintage shipment arrives at the right moment for devotees to replenish their supply. And they can look forward to alumni holding studio reunions for the next twenty-five years or so. AE

Tak Shindo: Brass And Bamboo
Capitol ST1345
Kimio Eto: Koto Music
World Pacific WP1278 (Mono)

In making a stereo debut as a concoctor of exotic sounds, Tak Shindo calls upon big-band dance orchestrations to introduce his mixture of two musical cultures. Although a native of Los Angeles, Shindo studied music in California and later, while serving with the U.S. Army, in Japan. Writing for television and films, one of which was *Sayonara*, keeps him busy today, and he is working on a history of Japanese music. The stereo stage is sprinkled with a liberal supply of Kabuki drums, Buddha temple gongs, ceremonial drums, bells, chimes, giant gong, and other Oriental noise makers. Happily, the arrangements offer more than the usual ping, bang, and whamp to impinge upon the senses. Featured on koto and samisen is a recent import from Japan, Miss Kazue Kudo, who conceals an inability to read Occidental music behind

the inscrutable countenance of the East. Aided by such stalwarts as the Candoli brothers, Milt Bernhardt, Ted Nash, and Bud Shank, she proves to be a quick study on *The Moon Was Yellow*, *Skylark*, and *Poinciana*. Shindo provides two originals, and Bill Holman helps out on three arrangements.

Those persons who form an attachment for the harp-like sounds of the koto can prolong their enjoyment, due to the arrival in this country of Kimio Eto. A student of the instrument since the age of eight, he is bent on revealing its charms to a new audience. Playing his own works and traditional themes, he displays great technical facility and creates, for the most part, a feeling of tranquility. Monophonic only, but a fresh sound for collectors of mood music. Remembering the successful collaborations of Bud Shank and Laurindo Almeida, perhaps Richard Bock will come up with an international trio. Æ

MICROPHONE

(*from page 35*)

ter, a mechanical protective rosette has also been added to protect the front of the microphone against hazards of careless handling by the user.

Measurements

The measurements made throughout this development program were carried out in the Altec Lansing Anechoic Chamber. The Anechoic Chamber is a room without echoes or reflections and duplicates a condition that would exist if the measurements were carried out at a point in space. It is an indispensable tool in acoustical research and development work. Such a room, when equipped with an accurately controlled loudspeaker as a sound source and electronic measuring gear having a servo-driven pen charting a response curve, is an instrument that has a high degree of accuracy and convenience. This chamber, externally $20 \times 18 \times 16$ ft, has 4-ft. wedges along all six inner surfaces and has a $12 \times 10 \times 8$ ft. working space. The design of the fiberglass wedges insures less than one per cent energy reflection above 70 cps, although the use of calibrated microphones allows measurements to much lower frequencies. The double walls are of heavy construction and are designed to provide large attenuation of air-borne sound. The Chamber is supported on blocks of a neoprene-and-steel laminate providing low transmission of ground vibration; when the utmost isolation is required, inflated rubber pads are provided to support the structure.

Much credit is due to Mr. William L. Hayes, who has conducted the bulk of experimentation and production tool design, to Mr. Edward S. Seeley for his mathematical analysis, and to Mr. A. Fiore for his production planning advice. Æ

AUDIOCLINIC

(*from page 4*)

gain of the oscillator to a positive certainty and dependability, so a very ingenious method devised to accomplish the required

stabilization. A bulb is placed in series with the cathode circuit of the tube to which the feedback is taken. One of the characteristics of the bulb is that its resistance changes with very slight changes in temperature. As the amplifier varies in performance, different amounts of current flow in the bulb. As the current tries to rise, the resistance of the bulb rises, and this rise compensates for the increase in current, and this increase is thereby minimized over what it would be if the bulb were not used. The reverse is true when the current falls. It's simple, cheap, and reliable. AE

LIGHT LISTENING

(from page 8)

the hopes of its producers. The source was a whimsical novel by B. J. Chute. Music and lyrics were to come from the famous and successful pen of Frank Loesser. The gangling talents of Tony Perkins were engaged to buttress the central role. As home entertainment, the score isn't good enough to put over the show on records. Adding to the disappointment is very shallow stereo that has the cast glued to the mikes in order to deliver directionality even on a portable dormitory unit.

Ted Heath: Pop Hits From The Classics
London PS 171

Evidently the demands of stereo console owners are still receiving consideration from London's recording directors when handling pop material. This stereo recording splits the orchestra into right and left halves. Most of the time the brasses on one side do not speak until the reeds have had their say in the other channel. The reeds then repay the compliment. Under such circumstances I suppose Charlie Console Owner finds it easier to convince himself that some of the attributes of stereo are attainable with a spread of only two feet between speakers. On a normal stereo setup, this split technique is quite old hat. I suspect that, by now, many component stereo fans would appreciate a clear marking on the jacket of a record of this sort. A simple legend declaring "For Console Use Only."

The musical content of this disc reveals somewhat more promise than my comments so far would indicate. Some of the conversions of classics from the pen of Tchaikowsky and Chopin have been around for a long time but Heath adds an occasional new twist. He also tackles some items that have so far escaped a widespread "descent to the people." Only a completely squeamish classics fan will find the fun less than innocent in the Heath treatment of Chabrier's *Espana* and Offenbach's *Can Can*.

The Three Suns: Twilight Memories
RCA Victor LSP 2120

Those following popular music for the past twenty years will find more than pleasant listening and meticulous engineering in this release. Here is an album commemorating two decades of the highly successful formula for Hammond organ, guitar, and accordian evolved by the Three Suns. The collection includes some of the most popular tunes of their career. Any veteran fan of the trio should find his original judgement vindicated in this latest stereo processing. Celeste, vibraphone, piano, bass, and drums have been added in some of the numbers without sacrificing any of the original easy-going style.

MONO

A Night With Jerome Kern
Columbia CL 1386

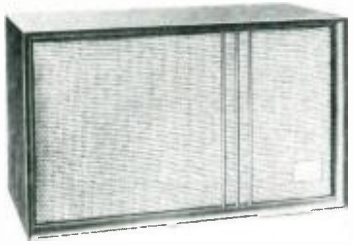
Someone at Columbia still holds to the theory that people want to hear the music of Romberg and Kern played without frills. Not too many months ago, a Romberg album was released starring Earl Wrightson, Lois Hunt, and Percy Faith's orchestra. That release preserved the atmosphere of outdoor summer pop concerts devoted to the operetta melodies of the Viennese light composers. In similar vein, a dozen songs are covered here as, individually or in duet, Miss Hunt and Mr. Wrightson thread their way through black-tie arrangements of ever-fresh Kern ballads. A highlight of the album is Wrightson's *Ol' Man River*. Apparently this classic can be sung without adopting a lugubrious expression. The miking is ideal—all the freedom of sound these stage songs require.

Can-Can: Original Soundtrack Album
Capitol W 1301

Purists to the contrary, the movie version of Cole Porter's Can-Can will undoubtedly entertain far more home listeners than did the Broadway original cast recording. Although the stage production ran for 892 performances, the major tunes in the show never reached the universal whistling status of the truly great Porter hits. With names such as MacLaine, Sinatra, Chevalier, and Jourdan on the movie marquee, the second audience for this score will find many of the songs reshuffled among the members of the cast. *C'est Magnifique*, sung by Lilo in the Broadway production, has now been assigned to Sinatra. *Come Along With Me*, a male duet on stage, is now the property of Shirley MacLaine. Lilo's *Live and Let Live* is expounded here by Chevalier and Jourdan. Added to the movie score—possibly as a precautionary measure—are Cole Porter reliables such as *Let's Do It, Just One of Those Things*, and *You Do Something To Me*. Scant evidence of the movie plot is found in this soundtrack album but the arrangements of conductor Nelson Riddle neatly highlight the personality of the current stars and his treatment of the score ranks with the better pit bands on the Main Stem. AE

NEW PRODUCTS

• **E-V Compact Speaker System.** Engineered to provide sound quality without compromise, the Regal 300 is a bookshelf-size system designed around premium quality components. The 12-in. foam-cone woofer has a 4-lb., 10-oz. ceramic magnet, a long-throw voice coil, and high-compliance suspension for extended bass response. An 8-in. midrange cone-type driver



uses a 1-lb., 6-oz. magnet, and is mounted in an isolated chamber to prevent interaction with rear wave pressure of the woofer. A compression-type horn-loaded tweeter takes over at 3500 cps. Frequency range is 35 to 18,000 cps. Dimensions are 14" h × 25" w × 13½" d. The Regal 300 comes in walnut, mahogany or limed oak, and is finished on all four sides. Complete specifications and prices can be obtained by writing Electro-Voice, Inc., Buchanan, Mich. **F-1**

• **ESL Stereo Cartridge.** The new C99 cartridge is of the electrodynamic type, and utilizes two patented, inherently linear D'Arsonval movements coupled to a unique "Micro/Flex" frictionless stereo separating system. Technical data include: vertical compliance, 5×10^{-6} cm/dyne; lateral compliance, 5×10^{-6} cm/dyne;

dynamic mass, 0.0025 grams; output per channel, 1.0 mv at 10 cm/sec.; channel separation, 20 to 25 db; frequency response, 18 to 20,000 cps ± 2.0 db (Elektra 35 test record). The C99 fits any standard changer or arm. The P99 is identical in characteristics, except that it is designed for use only with the ESL-S310 professional series arm. Electro-Sonic Laboratories, Inc., Long Island City, N. Y. **F-2**

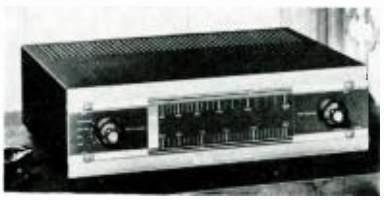
• **Monophonic Tape Player.** Developed primarily for heavy-duty continuous operation in music systems, the Crown-O-Matic Model A-51 incorporates a hysteresis drive motor and two ball-bearing motors for take-up and rewind. Additional features of this automatic player include a foolproof automatic photo-electric reversing system, straight-line threading, differential magnetic braking, plug-in preamp, and dust-proof plastic-enclosed relays. It is tested with thorough quality control, including the equivalent of one year of relay cycling, and one week of uninterrupted playing time before leaving the plant. The A-51 accommodates up to 14-

in. reels, and plays up to 16 hours of unrepeated time at 3¾ ips. Available normally for 7½- and 3¾-ips operation, the unit may be had for 1⅞-ips operation on special order. Signal-to-noise ratio is 50 db at 7½ ips, and wow is 0.1 per cent. Further information can be secured from Crown International, Box 261, Elkhart, Ind. **F-3**

• **Low-Cost High-Quality Microphone.** Excellent audio quality is afforded by this new dynamic cardioid microphone recently introduced by Akustische und Kino-Geräte G.m.b.H., Vienna. The D 11 N covers the full audio spectrum, and is equipped with a bass attenuation switch for voice which

cuts 8.0 db at 200 cps when desired. Sensitivity is 2.5 microvolts/millibar at 1000 cps. Despite its sensitivity and small size, this microphone is not affected by temperature from −20° F. to +160° F., even at high relative humidity. The D 11 N is imported and serviced in the United States by Electronic Applications, Inc., Stamford, Conn. **F-4**

• **Knight-Kit Deluxe Stereo Tuner.** Ingeniously designed, this tuner features independent FM and AM sections, and is available as an FM/AM stereo tuner kit, or as an FM tuner kit only, since the



"add-in" AM section can be purchased separately. The kit has space within its chassis for the addition of a multiplex adapter unit, with provisions on the panel for multiplex controls. An "add-in" multiplex section will be available as soon as the FCC establishes standards for multiplex broadcasts. Empoying a dual limiter-discriminator circuit, the FM section provides a sensitivity of 8.5 microvolts for 20 db quieting. Continuously adjustable a.f.c. and pre-aligned r.f. coils and i.f. transformers are other features of the FM section. The AM section features narrow and wide i.f. bandwidth for sharp or broad tuning, and a 10-kc whistle filter. Both the FM and AM sections have separate cathode-follower outputs with level-set controls, flywheel-weighted tuning knobs, and separate moving bar-type tuning indicators. For full information, write Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. **F-5**

• **Transistorized Millivoltmeter.** This instrument is an all-transistor portable audio-r.f. millivoltmeter, providing accurate measurements down to 100 microvolts over a frequency range of 20 cps to 200 mc. Battery operated, it has full-scale readings in 12 ranges from 1.0 millivolt to 300 volts. It contains a built-in video amplifier for simultaneous use with meter

to drive an oscilloscope, or wherever a highly stable broad-band amplifier is needed. Operation from standard type D flashlight cells eliminates any a.c. line connection and corresponding noise and interference problems. The low-noise all-transistor design of this instrument permits measurements directly at any point of a circuit with minimum loading. Normal battery life is more than 200 hours. Manufactured by Motorola, Inc., Communications and Industrial Electronics Division, 4501 W. Augusta Blvd., Chicago 51, Ill. **F-6**

• **Audio Signal Generator.** Designed essentially for measuring distortion in hi-fi amplifiers and the frequency response of audio devices in general, the Model 50 audio signal generator is a dual function instrument with both sine- and square-wave output. It also provides precise

measurement of amplifier input and output impedances and resonant frequencies of loudspeakers. It is continuously tuneable from 21 to 250 cps, and can be used for tuning bass-reflex enclosures and for determining unknown audio frequencies and the resonant frequency of an L-C cir-

cuit. Features include a fully-regulated power supply which covers 105 to 130 volts a.c. Output is continuously variable to 15 volts r.m.s. maximum. Hum level is 0.001 per cent of maximum output. Harmonic distortion is less than 2.0 per cent. For additional information write to Packard Bell Electronics, Industrial Products Department, 1920 S. Figueroa St., Los Angeles, Calif. **F-7**

• **Low-Price Stereo Amplifier.** Good performance at modest cost is inherent in the new Type LA-210 dual 10-watt stereo amplifier, which delivers a frequency range of 40 to 30,000 cps within ±1.0 db at normal listening level. Total harmonic distortion is 2.0 per cent at 1000 cps at full output; intermodulation is 3.0 per cent. Hum level is down 65 db. Stereo tone controls provide bass boost and treble cut. Dual-concentric volume controls afford individual or simultaneous adjustment for

rapid channel balancing. Two separate inputs have been furnished for each channel, with the amplifier designed to provide stereo or monophonic operation with record players containing crystal or ceramic cartridges, tuners, and tape recorders. In addition to tone and volume controls, the front panel contains a function selector, on-off switch, and a switch for speaker phasing. Full information on the LA-210 may be obtained from: Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y. **F-8**

• **EICO Hundred-Watt Dual Stereo Amplifier.** This impressive new amplifier, available in either kit or wired form, features less than 0.5 per cent intermodulation with a continuous output rating of 100 watts rms. Undistorted half-power points extend below 15 cps and up to 100 kc. Although developed primarily for combining with the EICO HF-85 stereo preamplifier, it will enhance the operation of any well-designed preamp. Each power amplifier is conservatively rated at 50 watts, and employs a cathode-coupled phase-splitter-driven circuit, preceded by a direct-coupled voltage amplifier. Ultra-linear connected, fixed-biased, push-pull EL34's are used in the output stage and provision is made for both bias and d.c.-

balance adjustments. The very low impedance characteristics of silicon-diode rectifiers give the common power supply for the two amplifiers exceptionally good regulation. As a result, signal conditions in one amplifier have negligible effect on the operating conditions of the other. Specifications supplied by the manufacturer indicate that this is one of the truly remarkable power amplifiers to come along in quite a spell. For complete data, write to EICO, 33-00 Northern Blvd., Long Island City 1, N. Y. **F-9**

ABOUT MUSIC

HAROLD LAWRENCE*

Wrecker, Spare That Hall!

THE ELEVENTH-HOUR rescue of Carnegie Hall from the demolition crew dramatized the scarcity of old concert halls in our country. Television, shifting populations, and urban concentration are three of the factors that threaten the future existence of the large music auditorium in America. Among the halls which have already fallen victim to changing times is a fine structure that was once the home of the Detroit Symphony Orchestra, located on what was formerly the Motor City's most elegant residential avenue. When the migration to the suburbs approached its climax in recent years, the orchestra moved to new quarters, and the hall became a movie house named the Paradise Theatre. The impact of television on neighborhood movie palaces, however, drove the large Theatre out of business. It re-opened as a Negro temple. Meanwhile, urban decentralization had caused the neighborhood to slip into skid row, and the congregation abandoned the hall. Now even the real estate operators gave up hope of renting their lonely theatre.

A New Lease on Life

Two years ago, the Detroit Symphony asked permission of the owners of the Paradise Theatre to use their old home as a recording site. The request was granted joyfully, and at a more than reasonable fee; but there was one stipulation: the orchestra would have to assume the job of cleaning the hall. This proved to be no routine chore. At this point, the Paradise Theatre resembled Miss Havisham's wedding banquet table, with its rotting bridal cake, moldy linen, and tarnished silver (Dickens's *Great Expectations*). The ceiling above the proscenium contained gaping holes through which the rain, the snow, and the pigeons entered freely. There were other intruders, too. Vandals had jimmied their way into the theatre and done their usual work of ripping seat cushions, pulling out anything not too securely nailed down, and slinging objects at the chandelier. Miraculously, the lighting system was still intact, though the weather-beaten stage planks creaked and moaned with the slightest pressure. This "modern antique" was chosen because of its acoustical virtues. The theatre's reverberation period is just long enough for a symphony orchestra, and the irregular pattern of wall and ceiling surfaces makes it generally free of frequency-selectivity.

At first, the musicians arriving for the sessions were less concerned with acoustics than with comfort. For one thing, the theatre's plumbing system had long ago ceased to function. Illumination, too, was a problem. In order to take full advantage of the hall's acoustics, the orchestra was moved as far forward (into the auditorium) as possible. Thus, the outer rows of first violins and cellos were perched on the very edge of the stage apron where the overhead lights were less bright. Most of the players took this in stride, but Mischa Mischakoff, the Detroit Symphony's able concertmaster, pleaded poor visibility; he later obtained an old-fashioned floor lamp (with tassels) which he plugged into the stage outlet near his stand, thus lending a mid-Victorian flavor to the sessions. The neighborhood pigeons, perhaps startled by the sound of a symphony orchestra, stayed away from the hall during the sessions. The rain was not as bashful. During one brief spring shower, drops spattered on French horns, clarinets and the bald pate of a double-bass player.

The musicians quickly adjusted to dust, plumbing, lighting, and the elements, but it required a good portion of a rehearsal to adapt their playing to the hall's acoustics. The sonic contour of an orchestra is formed to a certain extent by its acoustical setting. After nearly two decades of performing in Studio 8-H, the NBC Symphony, for example, acquired its characteristically dry, tight, and steel-like texture as much from the hall as from Toscanini's baton. With a reverberation period of less than a second, the players had to "dig in" to generate volume: the strings bore down on the bow, the brass blew roughly, and the timpanist produced a curiously one-dimensional assortment of thuds and slaps. Studio 8-H was an extension into the concert music world of the acoustical concept that grew out of the early days of radio when the paramount need was to eliminate outside noises and to obtain absolute clarity. Along the way, in the design of 8-H, the beauty of sound inherent in the symphony orchestra was sacrificed. Acoustical engineers today regard it as a poor music auditorium by any standards, though the tendency is clearly away from 19th-century concert hall acoustics. London's Royal Festival Hall set the pattern for many of the concert halls constructed in the 1950's, including the Ford Auditorium (1956), present home of the Detroit Symphony Orchestra.

For two seasons, the Detroiters had performed in their new hall. Now they were about to return briefly to an auditorium built along 19th-century lines. During a run-through of the first work on the program, the players gradually sensed that something was wrong with their performance. They were all playing too loud; passages marked *piano* emerged *mezzo-forte*,

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

and *forte* bars nearly tore the roof off the theatre—which would not have been too difficult in view of its dilapidated state. It soon became clear to the musicians that they could now achieve the same volume level with less effort, or, to put it in audio terminology, they had been converted from low-efficiency to high-efficiency "loudspeakers." It was as if their tones were magically lifted up, expanded, and endowed with new color. The effect was like playing a grand piano with the lid raised, after having practised on it for a long time with the lid down—the latter condition aggravated by the sponge-like quality of capacity audiences in the Ford Auditorium.

Old Halls and New

The architects of today's music auditoriums keep the reverberation time at a minimum, usually 1½ seconds. Their chief concern is with distribution and clarity. Through the use of overhead panels, or "clouds," they can reach all parts of the hall without the annoying delay that plagues many older concert halls, and, by means of a short reverberation period, they can secure an almost X-ray "picture" of the orchestra. Modern acoustical engineers reluctantly admit that some excellent halls were built in other days, but they claim that their good acoustics were the result of such purely accidental sound diffusers as statues, candelabra, friezes, and other ornaments. It would be silly to state that age in itself is a prerequisite for good acoustics; e.g., London's Royal Albert Hall. Even the best of the older music auditoriums, such as Carnegie Hall, contain grave defects. At the same time, it is equally wrong to ascribe the excellent acoustical properties of certain old halls to chance alone. A re-evaluation of concert halls, hallowed and otherwise, would seem to be in order. Æ

LOUDSPEAKER

(*from page 27*)

pressed it took about 5 seconds for it to return to the neutral position. This enclosure was considered satisfactorily tight for use in these experiments.

The instruments used in taking the data were:

Sine wave generator, Hewlett-Packard, Model 200CD
AC VTVM, Ballantine, Model 861
Electronic Counter, Hewlett-Packard, Model 521-A
Oscilloscope, Sylvania, Type 403
Microphone (calibrated), Electro-Voice, Model 655C
Power Amplifier (100W), Electro-Voice, Model 6006
Logarithmic Translator, Electro-Voice, Model 6700
Beat-Frequency Oscillator, General Radio, Type 1304-B
D'Arsonval Movement, Rectilinear Recorder.

(*Part Two will follow in a month or so*)

AUDIOMAN NO. 9

Now retired in Florida, T. H. Kuykendall, who built amplifiers before the term "hi-fi" was known and misused, becomes the latest to join the select group.

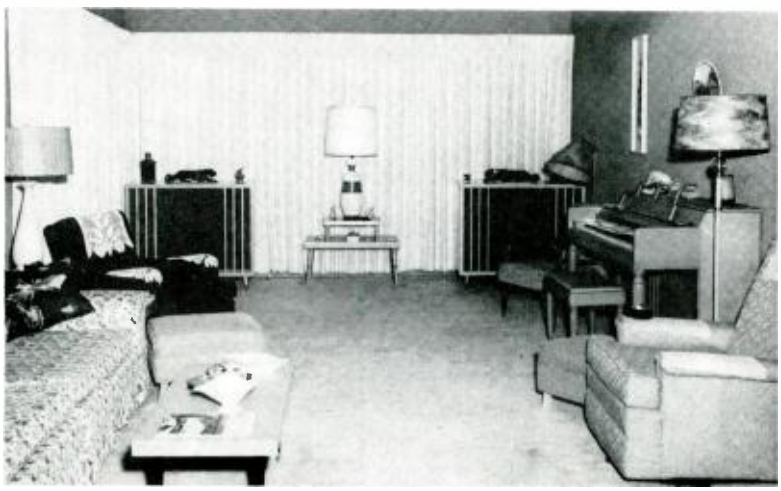
HOLLY HILL is a comfortably small town not far from Daytona Beach—an ideal place to settle down and enjoy music as a hobby. And, the better to enjoy music, this month's Audioman builds much of his own equipment, thus providing himself with something else to do that he is interested in. Mr. Kuykendall now boasts a system which provides him with both recorded and radio music in a fashion that pleases both himself and his wife. He uses a H. H. Scott 130 preamp with an Acro Ultra-Linear II 70-watter and a Heathkit 60-watt W-6M feeding two Heathkit HH-1 loudspeaker systems, as shown in the photo. The "listening room" is of good proportions, and the ceiling is on a slight slant, further improving the sound quality by reducing floor-to-ceiling reflections. Two Heathkit tuners—BC-1A and FM-3A—provide for radio reception, while a Gray HF-500 turntable and 216-SP arm with a Pickering 371 stereo cartridge serve for record reproduction. The equipment is housed in a home-built cabinet along the right side of the 28-foot wall of the room, and contains space for his 175 records, a good number of which are stereo.

Mr. Kuykendall serves as a hi-fi consultant for friends, neighbors, and even dealers, and they call on him for information several times each month. He has helped install, design, or plan thirteen complete systems, and has helped some fifty people altogether. Naturally he is an avid reader of AUDIO.

He has other hobbies too, such as cabinet making, traveling, preservation of wild life, baseball, and fishing, and he goes to concerts and plays whenever possible. He admits to playing the piano, but "not well," he says. He also takes part in community activities, United Fund drives, and so on.

It may be an old story, though we hadn't heard it before the way Mr. Kuykendall tells it on himself. It seems he built an equipment cabinet for a friend and together they decided the legs were 2 in. too long to look right. So out comes the saw and he is about to start cutting when the friend announced that he had just passed the exam for broker and that a toast was in order. After several slices (?) of toast, he picked up the shaw again, but shomewhere along the line he sheemed to lozhe count of legsh, 'cause five pieshes had been cut off. Of course it wasn't really his fault—his friend had no business passing the examination, the distiller should not have let the toast get so old and smooth, and—he insists—his wife should have been there to tell him when he had cut off the required four legs.

Following the old Stoopnagle and Bud technique would have saved him embarrassment—all he had to do was to bore four holes in the floor for the too-long legs to fit in. If he had bored a fifth they could have drunk it too. Or used it for an umbrella stand. Æ



TANDBERG COMMENTS

Vebjorn Tandberg, builder of the well known tape recorder which bears his name, has a few words to say about 1⅞ ips.

IN A LETTER directed to Eric Darmstaedter, president of Tandberg of America, Inc., Vebjorn Tandberg expresses his opinion of some of the claims made for the newly announced low-speed tape system. We are fortunate in being able to present this letter *in toto* to our readers, since the excellence of his product attests to Mr. Tandberg's competence in the tape field.

Dear Mr. Darmstaedter:

"We have read through the technical report and are really pleased to discover that this system does not introduce any new technical features or new patents. In fact, we were a little afraid when you first mentioned the system, but the detailed report took away our headache (while we understand that yours still remains).

"At the moment we are having a clean and inspiring fight against the discs. *Our key card in this fight is our quality.* The recording companies cannot beat this quality at the moment.

"It is the RCA cartridge story once again. It is possible to design a playback machine with a higher quality for 3¾ as well as 1⅞ than in our running models if the machine is specially designed for optimum performance on these speeds, but this quality will always be far inferior to the quality obtained by optimum performance on 7½. In our opinion the quality on 7½ is still not sufficient and the main work should be laid on increasing the quality on the highest speed instead of making systems which more or less 'approach' this quality.

"As you know, we have worked with 1⅞ ips for six years and are well familiar with the possibilities obtainable by conventional methods. We would only point out a few things:

"Looking at the recording equalization you will find that the boost from 1000 to 5000 cps is approximately 8.5 db. Even with an optimum record-head gap (which is ten times the gap necessary for playback), the record current must be approximately 8 db below the record current at 1000 cps for the same IM distortion. You may look at the curves showing the energy distribution of normal music (Fletcher or the later ones from the Ampex people) and try to find program material with an energy distribution suitable for the CBS system.

"Further, if you record a 13,000-cps note on 1⅞ with an IM distortion corresponding to *3 per cent* harmonic distortion at 1000 cps, and measure the noise level including the modulation noise, you will find a negative value, especially if you use a 40-db weighted playback response.

"All this confusion regarding the low speeds is due to people taking only two quality figures into account, viz. (1) *frequency response* and (2) *noise ratio referring to erased tape.* These two factors alone are not decisive for quality. In fact it is easy to obtain rather good figures at lower speeds when sacrificing other qualities which are, of course, not mentioned. The weakest points in tape recording at present are the *modulation noise* (the *'hiss'* and the fallouts) as well as *intermodulation on the higher notes.* These things are much more notable at lower speeds and increase rapidly with smaller recording gaps.

"If, however, the CBS or RCA cartridge machines are to be able to record with a quality only a little better than a normal dictating machine, it is necessary to use separate playback and record heads. It will therefore be a rather expensive machine.

"In our opinion both systems have their justification, viz. as a cheap mass product for youngsters etc., but the difficulties for the designers are that the system is so complicated with the result that the price will be too high. Therefore the makers try to introduce them on the Hi-Fi market.

"You must do everything to persuade the magnetic industry to adhere to a firm and clean policy based upon the fact that the quality of 7½-ips recordings is not good enough, and all efforts in tape and head improvements must be to the benefit of this speed. The quality is and shall be our weapon. And do not forget that the playback action is only one part of the recorders' possibilities. The machine must also be a good sound *recorder.*

"It is quite unrealistic to compare the actual situation with the appearance of the long-playing discs. The LP discs gained the victory *because of a higher quality.* As long as we stick to the 7½-ips quality or better we will never lose the Hi-Fi market.

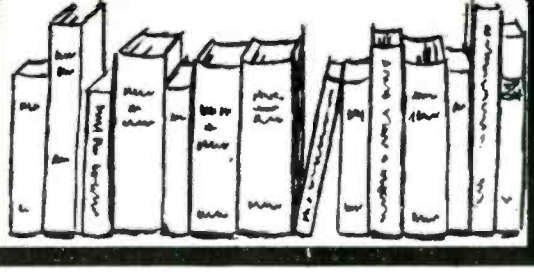
"As long as the tape industry keeps to such a policy the industry will only benefit from new confusion. We have a world-standardized reel-to-reel system which exists and will continue to exist with a higher quality, whereas the new systems have to fight their systems through with inferior quality. For customers interested in high quality, a 7½-ips reel-to-reel machine is the safest purchase.

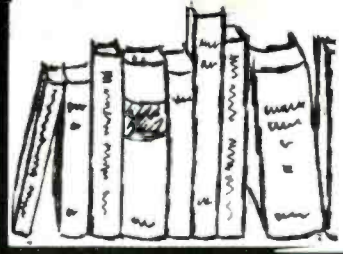
V. TANDBERG."

Model 6 Introduced

A new model of the Tandberg has just made its appearance. Complete flexibility, with built-in stereo record and playback amplifiers, and the elimination of an "outboard" second record amplifier are among its features. No power amplifiers or speakers are built into the Model 6, but must be furnished externally.

The new Tandberg Model 6.





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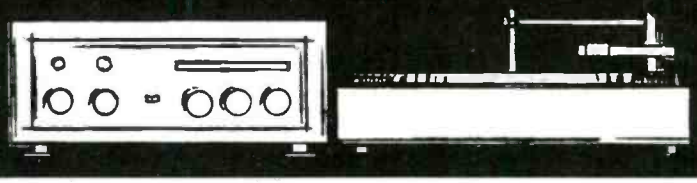

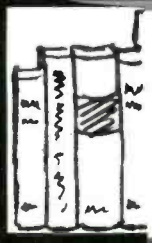

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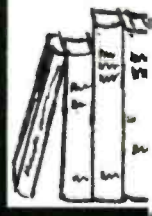

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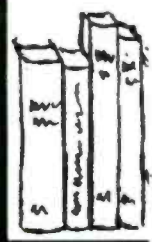

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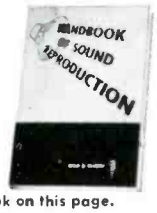

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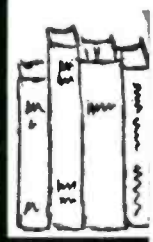

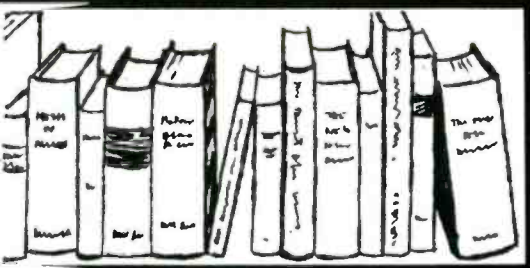

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AUDIO ETC

(*from page 14*)

of the 14-watter, after awhile, and thereby achieved an ideally balanced system; but it was abundantly clear that I could also achieve useful, workable, acceptable stereo via almost any power amplifier I had around—whether higher or lower in its rating than that in the Sherwood S-4400 cabinet. It was clear, more specifically, that the variables that counted were mainly (a) effective input sensitivity and (b) output matching, including such things as damping—but these factors are generally adjustable on most amplifiers, or are flexible enough to encompass likely requirements without serious trouble. (Note that Sherwood provides 10 : 1 damping at the output but has an alternative 2 : 1, by opening a metal link at one terminal.)

It seems to me, then, that the only serious difficulty to be anticipated in using this type of stereo conversion with your old single power amp is that of abnormality in the old system—the faults of old age. If the old beast distorts, oscillates,—emits nasty 15,000-cps tones that pierce younger listeners' ears—if it produces hum, or undue hiss, sputter and what-not, then you are going to have lop-sided stereo, with trouble in one speaker and not the other. But given an amplifier that works as it is supposed to, you're in business here with a minimum of trouble. I am all for the one-power-amp-dual-preamp-with-controls unit.

Having left the details to the editor, I'll only say that this Sherwood unit has proved one of the quietest I've ever used, with less hum and tube hiss, even at wide-open volume settings, than I have experienced so far in any stereo system. Hasn't developed any in use, either—so far. "So far" is enough months so I can assume I'll have no trouble in as many more, at a minimum. Very nice equipment.

P. S. I usually can dig up a minor gripe or two concerning any equipment. I'll push only two, here. First—a silly one—the "RCA-type" sockets in the Sherwood rear are like leeches. Don't know what does it, but you can't get a plug into them without practically breaking it—and getting the plug out again is a real operation. Fine for a permanent installation! (Maybe they got some of that greenish lacquer down inside the holes. That would do it.)

Second, one minor caveat in respect to the otherwise excellent control arrangements. On the rear of a number of Sherwood units there are two pots—volume controls—with small turning knobs. One is an expected level-set. The other is utterly different, having to do with tube balance, for hum minimizing. Also, a switch for testing or regular operation. Fine, but the level-set and tube-balance pots are so close, and so much alike, that it's dollars to doughnuts you'll hit the wrong one 50 per cent of the time. They are marked; but who can read the backside of a unit in most situations? They ought to be outwardly different to the exploring fingers or screwdriver. And the test switch is easily left in the TEST position by happenstance. I did it.

Very minor points—just worth mentioning.

* * * *

3. DON'T THROW IT OUT

Changer—Anonymous

To balance the favorable accounts presented in several of these descriptions of the history of my older hi-fi, I must say that another excellent reason for me to keep old equipment lying around for periodic use is to see when—and if—it falls apart.

It's just as well, I think, that even with my relatively leisurely sort of in-use testing, some equipment gets written up in this column before it has had a chance to fall apart. It does, but later on.

Granted that in the interests of the consumer it might be fine for me to wait at least a full year before reporting on any equipment I use. That would allow for most tendencies towards total collapse to reveal themselves. But . . . well, obviously, in our high-speed age this would never do. Who wants to know about last year's Chevrolet, good *or* bad? (We still don't have a real second-hand market in hi-fi, though I've always thought we ought to.)

Take, then, one fine example, a changer that must remain very, very anonymous. I've had it on hand less than a year, I think. It has been around, recently, as a stand-by for emergencies when other equipment was under alteration or otherwise out of service; I've carried it about in my car and it has had a fair share of the world's knocks and bumps, but nothing really drastic as far as I know.

This week, I took it out for temporary duty in my record review department. The following things were wrong with it though for awhile I managed to go along with the darned thing, for lack of anything else with which to work at the moment.

1. The entire control housing, to the right of the changer where the arm head rests, was loose and proceeded to come off in my hands, dangling various small springs behind it. I swore, forced it back in place and found that, miraculously, the START button still operated, through a hole in the panel, though the manual-play department was non-functioning. I had no time for fiddling; I went ahead and played records, automatically.

2. The automatic start worked, but every so often the final operation that connects the table to the motor drive just didn't connect. The motor turned, but not the table. I swore once more, pushed the START button, went through the entire cycle—and usually it worked the second time. I didn't have time to . . . so I went back to my listening.

3. Then I played what I thought at first was an off-center record. The pitch wavered. Horrid. The odd thing is, it was indeed a bit off-center; but the next record wowed too—and I swore. Another examination, while my ears waited; yep, the changer was off on another tear. Now, it was connecting for the 33 speed, but just barely. Touch the table and it would stop, without enough contact to start up again. Give it a whirl and it would keep going—more or less—at 33. I swore, pushed the d——START button again, found that after a couple of false starts, the thing unconcernedly grabbed hold and played OK—you couldn't even stop the table without stalling the motor.

4. A few seconds later, same thing again. Ghastly wow, just enough to render the music sea-sick without stopping it altogether. Swore. Pushed START button through three cycles, and it worked OK again. Forgot about it. . . .

5. Next morning: slippage again. Bartok's "Music for Strings, Percussion and Celeste" heaving like the stormy sea. (It heaves plenty without help from the turntable, thank you.) Swore, tried again, worse. Swore, gave up. Removed turntable, couldn't make head or tail (as usual) of the complex mechanical levers, arms, wheels, and could see nothing wrong. Decided, desperately, to lubricate. Carefully edged in a bit of silicone here and there, NOT on the drive wheels and shafts. Oh boy, was I careful. Things seemed to shift gears more easily, was encouraged. Put back turntable, started up Bartok. Swore.

This time the LP speed had a two-cycle wow, on each revolution. On one half-cycle the pitch went up, Woo-ee-ooo. On the other half-cycle it went down, Whoo, oh-oo. Bartok spinning in his grave.

Swore violently, grabbed up changer and pulled out all three cables (two stereo leads, one power), managing to unhook several others in the process. Entire control panel fell off on the floor with a crackling bang, picked it up and put it back. Attached large card for my assistant marked RAY: FIX!! Dismantled my bulky radio broadcast turntable system, moved whole thing out of studio into living room, hooked it into stereo amplifier (fifteen minutes more)—and went back to playing records.

* * *

You see, the worst part of all this is that the troubles were, I knew perfectly well, minor ones, involving adjustment, loose screws and the like. But like most home users, I'm not the mechanical sort who drops music for nuts and bolts with glee. I prefer music and, in fact, would buy any changer only for its music. I *hate* to be interrupted at my business of enjoying, criticizing recorded sound. So do most home owners.

But of course, curiosity is a major force in my life, too. Having swore and swore, ungrammatically enough, I now sense a curious interest in finding out just what DID ail that silly machine. And I will. Chances are that it will be back in "service" again fairly soon, for another hopeful trial. This is one reason why I gotta have an assistant. I'd go nuts without one.

I should remark, quickly, that the current model of this changer has been modified from the original in just about these exact spots, to correct what were actually fairly superficial faults, all in all. Since writing the above, my original machine has, indeed, been fixed up and works again like a charm. Extra hold-down screws will keep the control panel in place until doomsday; the wow is gone.

Do Throw It Out

Anent the young lady (AUDIO, March, p. 14) whose phonograph played the music too slowly, but right on pitch—I now have her latest and very sad experience. The machine she has cost $85. It is a flat portable, about 4 inches high at most, with a microscopic speaker somewhere in the frontal area, and sounds like . . . well, I'll forego comparisons. It was really ailing after all. She took it to the "factory," in desperation, after deciding to avoid all local repairmen. The thing was an import and the "factory" was a good hour's subway ride out in the New York suburbs.

Out she went and, after a couple of weeks, out she went again, to pick it up. It was fixed all right, to the tune of $38. The motor was "burned out" and they said something about cold solder, too. Might be a couple of loose connections, I'd guess. This was the second "burnt-out" motor in a year. She paid only around $15 the first time.

When her next motor burnout comes along, probably about August 1, she's going to buy components if I have any say in the matter. Even if it's only $85 worth.

Æ

STEREO PHONO PREAMP

(*from page 21*)

cartridge we should use the circuit of *Fig.* 8.

$$R_x = \frac{3250 \times 4000}{56{,}750} = 3550 \text{ ohms}$$

Again we have our choice between the nearest 10-per cent tolerance resistor, 3300 ohms, and the nearest 5-per cent tolerance resistor, 3600 ohms. In this second case there is even less reason to use the 5-per cent resistor since the error here has more effect on the voltage division than on the frequency response.

To illustrate the other general case let us consider a cartridge where the output impedance is essentially resistive. A typical cartridge of this class may have an inductance of 3 or 4 millihenries and a resistance of 600 ohms. Under these circumstances we may neglect the effect of the inductance and consider the output impedance of the cartridge to be a pure resistance. To achieve the proper rolloff in this case we must shunt the input of the preamplifier with a capacitor, the reactance of which is equal to the output resistance of the cartridge at a frequency of 2100 cps.

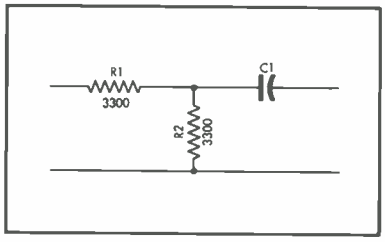

Fig. 8. Method of connecting input resistors to provide correct load and reduce input signal.

The value of the necessary capacitor is given by:

$$C\ (in\ \mu f) = \frac{75}{R}$$

For the values given $C = \frac{75}{600} = 0.125\ \mu f$

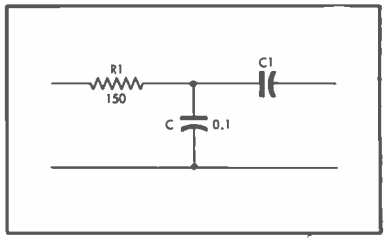

Fig. 9. R_2 of Fig. 1 is replaced by the 0.1-μf capacitor.

The nearest standard value is 0.1 μf. This is quite an error which may require either two capacitors in parallel to give the correct value of a 150-ohm resistor in series with the input lead from the cartridge as shown in *Fig.* 9. This extra resistance will have a negligible effect on the output of the cartridge at low frequencies.

Here we see that R_2 of *Fig.* 1 is replaced by the 0.1-μf capacitor.

PARTS LIST

R_1, R_3	See appendix
R_2, R_{12}	470 k ohms, ½ watt
R_4	47,000 ohms, ½ watt
R_5	33,000 ohms, ½ watt
R_6, R_{11}, R_{16}	1500 ohms, ½ watt
R_7, R_{14}	27,000 ohms, ½ watt
R_8	270 k ohms, ½ watt
R_9, R_{18}	15,000 ohms, ½ watt
R_{10}, R_{15}	1000 ohms, ½ watt
R_{13}	18,000 ohms, ½ watt
R_{17}	1 megohm, ½ watt
R_{19}	68,000 ohms, ½ watt
C_1, C_2, C_4	10 μf 25 v, electrolytic
C_3, C_7	.05 μf 200 v, paper
C_5, C_{11}	100 μf 25 v, electrolytic
C_6	50 μf 6 v, electrolytic
C_8, C_9	100 μf 15 v, electrolytic
C_{10}	500 μf 15 v, electrolytic
Q_1	2N104
Q_2, Q_3	2N405
Q_4	GT34
D_1, D_2	1N91
T_1	Filament transformer, 6.3 v, 1a.

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TAPE GUIDE

(*from page 40*)

corresponding to minimum distortion. To prevent excessive distortion, it therefore becomes necessary to reduce recording level somewhat.

At 15 ips it is generally feasible to set bias current for minimum distortion without impairing frequency response. At 7.5 ips it is usually necessary to settle for a value of bias current somewhat below the minimum distortion point. At 3.75 ips it is necessary to employ bias current well below that which achieves minimum distortion. And the situation grows considerably worse at still lower speeds.

One might ask: Why not compensate the increased treble losses at slow speeds by greater treble boost in recording instead of by a reduction in bias current? The answer is that greater treble boost would tend to overload the tape.

Mechanical Distortion

Distortion may be due to mechanical rather than electronic factors. If the tape does not pass smoothly over the heads, the result may be what is known as modulation distortion. Friction between the tape and the head may cause the tape to undergo a sort of vibratory action, akin to the effect that a bow has upon a violin string. The result is that the frequencies being recorded or played back are modulated at the vibration frequency. Thus the vibration frequency or frequencies are impressed on the audio signal and are manifest as distortion. Friction between the tape and the heads

may be due to accumulation of tape oxide or other material on the head, or to a tape that is not sufficiently polished or lubricated.

Wow and flutter produced by the tape transport mechanism may also be considered forms of distortion. Wow is apparent as a quavering in the pitch of a prolonged tone. Flutter, consisting of speed changes that take place hundreds or even thousands of times per second, serves to modulate the audio signal, so that the flutter frequency or frequencies become the distortion products. Accordingly, the sound tends to take on a grainy quality. Æ

RECORD REVUE

(*from page 55*)

walrus face; you'll hear the same friendly personality in the playing, straight through the medium of a huge orchestra. So great is his force that, paradoxically, he needs no ranting and tearing of hair to get his musical effects.

The sounds of the big Stravinsky orchestra are absolutely ravishing on this disc—many more sounds than you would have believed possible and each one utterly musical, natural to the soul of its instrument. It's hard to know whether RCA Victor provides this magic or Monteux himself. This ensemble, far from being suspended in a sonic vacuum, is superrealistic in a grandly effective liveness.

The return of Monteux is the best thing that has happened to Boston since 1924, when he left as permanent conductor in favor of Koussevitsky. The man is merely 85 now; he began his orchestral conducting at the age of twelve! His style—even for Stravinsky—is now mellow and nicely old-fashioned. But his musical sense is timeless.

Shostakovitch: Cello Concerto in E Flat, Op. 107; Symphony #1, Op. 10. Rostropovitch; Phila. Orch., Ormandy.
Columbia MS 6124 stereo

I sat in, at Philadelphia, on the first American playing of this new concerto, with the visiting Russians a few feet above me in a box, Shostakovitch himself leaning forward with that keen, Dick Tracy look of his, nervously intent on every passage. The famed Russian cellist, Rostropovitch, made such strange, strangled faces throughout the incredibly taxing work that I could scarcely listen to him. But my impression is that he plays much better here, a few days later and for the mikes, than he did before that audience.

Editing? I wouldn't know. Sometimes, though, the recorded medium has advantages over the live concert even without editing. It *must* be more perfect, and it often is; the medium demands it. You'll note that very few performance recordings are issued, and the reason is not entirely because of noisy audiences or even a firm union policy. The recording session is a better bet for the music—as it appears on records.

The late-Shostakovitch to me is appealing, for this habitually prolix composer has concentrated his style, thinned out a lot of the tonal underbrush, strengthened his melodies, built up his counterpoint, put reserves on his climaxes. It is real music now, if quite thoroughly unrelated to any Western development of these last years. Like late-Debussy, or even late-Beethoven, this Russian music seems headed into a noble impasse but yet an expressive zone worthy of its efforts. Nobody else in Russia, excepting only Prokofieff, could write music as good as this, nor will for awhile.

Extraordinary playing by Rostropovitch—it doesn't even have a cello heaviness but sings so easily (often in very high register) that you may forget your usual dim feelings towards cello solo music. Doesn't apply here.

Symphony Number One, the 'teen-age product of the brilliant youth-genius, gets a typically deft Ormandy treatment, too fast, too polished for my taste. It's a youthful work of brashness and overstatement; let it remain so, I say, for better or worse. This version will go down easily enough for sophisticated listening and it does sound a lot more suave than it really is. I fondly remember Stokowski's hammy early version—and you'll find that one, done new, on the United Artist label. Probably will infuriate you, where this one will make you purr, drowsily.

Debussy: La Mer; Danses Sacrée et Profane.
Roussel: Bacchus et Ariane, Suite #2. Lamoureux Orch., Markevitch.
Deutsche Gramm. DGS 712040 stereo

Beethoven: Overtures (Coriolan, Leonore #3, Consecration of the House, Egmont). Lamoureux Orch. Markevitch.
Deutsche Gramm. DGS 712019 stereo

Here is Deutsche Grammophon's French department hard at work, one record all-French and the other all German. Fair division.

Markevitch, one of the last of the emigré Russians to join that amazing Franco-Russian school of activity that centered around the great ballet impresario Diaghilev, is a brilliant conductor of French music. Here, his Lamoureux orchestra does a taut, tasteful job on the Debussy and Roussel. As for Roussel, it's no coincidence that another Franco-Russian, Koussevitsky, used to play that composer regularly in Boston, which is almost the only American town to know him well. Roussel seems to be one of France's lost-cause composers (in the outside world), as Delius is in England. For all his impeccably stylish writing, most of us find Roussel competently long-winded, though technically interesting via pungent and effective orchestral writing.

The Debussy Danses, composed on order to show off the then-new chromatic harp (it could play anything), are as we now see them pretty derivative—from other Debussy. He wasn't above that sort of thing by any means, when opportunity offered, and he did it well. The harp never sounded so harpy; but the music is dated.

As for the other disc, the reverse-twist Beethoven (German music by a French playing ensemble for a German record company), it is a fine example of the best French treatment of that composer—and it will sound pretty funny to non-French listeners. Somehow, French Beethoven is blatty, tinny, thin and over-tense, minus the fine German dignity that *we* (whoever *we* are) think it must have. The French worship Beethoven just as we do; but they like him in their own style.

Part of it is in the French wind instruments, notably the blatty, wobbling horns (with vibrato—utterly unthinkable in Beethoven). But there's more to it than that. Best thing is just to listen and get used to thinking like a Frenchman; then this Beethoven will reveal its considerable strengths to you.

The stereo in these records is of the ultra-mild sort, at a distance, with only a subtle degree of separation. I'm all for stereo with taste and moderation—but this goes too far. It is somehow unfocussed, too far away and not wide enough. Not for my speakers, anyhow. Might as well be mono, which would be OK with me if there weren't such a price-difference between the two.

Debussy: Violin Sonata
Lekeu: Violin Sonata in G. Arthur Grumiaux; Riccardo Castagnone.
Epic LC 3667

This is an outstandingly good performance of the late Debussy sonata, his last complete

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work. The Belgian violinist has a superb ear, a fine sense of French style and a lively feeling for dynamic contrasts. This somewhat eccentric music isn't easy to project by any means—this performance does it brilliantly. The pianist, Castagnone, is an able partner and could be played up a bit more, both on the album's cover and in the miking. (He's just a bit farther in the background than is desirable for this teamwork sort of violin-piano music.) Still, an unusually fine recording, with good sound in mono.

The bulk of the record surface goes to a lesser and much longer-winded piece, the sonata by a follower of César Franck, Lekeu. It's pleasant, but dated and, more important, well-padded. Franck himself is a better bet by far and even Chausson does more in an equivalent space. The record is important for the Debussy.

Tchaikowsky: Symphony #5. Vienna Philharmonic, Krips.

London CS 6095 stereo

I like the Viennese Tchaikowsky. Where so many orchestras whip his music up to frenetic fury to the detriment of musical sense, this orchestra under Krips keeps things always under reasonable and relaxed control, building fine climaxes but humanistic ones. This is in the Viennese musical character, of course; melody of an old-fashioned sort gets its due there and pageantry is buttressed by musical common-sense. Krips keeps his Tchaikowsky non-stodgy throughout; my only reservation in an otherwise well-behaved and expressive rendition is that not enough care is given to raveling up the inner details, the countermelodies, the connecting lines of thought, which are the foundation of any solid musical performance. A common enough failing and only an occasional one here; it takes a Monteux to enforce the ultimate in this respect, and Krips is merely following common practice in these mass-production days.

Brahms: Symphony #1. Vienna Philharmonic, Krips. London CS 6095 stereo

While we're at it, here's the same team playing home-grown music, to more ponderous effect. Tchaikowsky is an interesting alien, but the Viennese take their own Brahms and Bruckner very seriously. Brahms in particular seems to have bogged down more heavily than ever in Vienna, while he is whirled at jet speeds or whammed into unseemly overtension in other localities, all in the name of progress.

This is solidly old-fashioned Brahms, then, fraught with solemnity, the heavy opening drumbeats like measured thunderclaps, the grand themes taken slowly, the climaxes big and unreserved. The music gets off the ground all right, as we might put it anachronistically, but it wallows in the air.

It is we who are anachronistic to Brahms, of course; he is increasingly of another and more leisurely age than ours. This is he in all honesty, if not at his best, then at his most authentic; and he is probably better so. Given a bit more inner animation—this version is a bit tired here and there—we might have n definitive reading in the old manner. Almost. AE

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Industry Notes...

ALTEC SALES GROUP. Formation of a national sales organization for **Altec Lansing**, a **subsidiary of Ling-Altec Electronics, Inc.**, was announced recently by Altec Lansing's president Alvis A. Ward. National sales manager for the new organization will be H. S. Morris, former product sales manager for Altec high-fidelity and communications systems. In the new organization there will be ten districts covering the United States, each with a regional salesman. All of these salesmen, according to Mr. Ward, will have experience in both high-fidelity and industrial-sound installations. Present distribution of Altec products through **Graybar Electric Company** will be discontinued effective June 30, Mr. Ward said.

CROSBY APPOINTS GRAYBAR. Agreement has been reached between **Crosby**

(Continued on page 73)

Electronics, Inc., and **Graybar Electric Company** for Graybar to take over the distribution of Crosby's Madison Fielding line of stereo high-fidelity components in a number of Graybar outlets. The Madison Fielding line consists of tuners, amplifiers, complete receivers and multiplex adapters. The agreement covers the West Coast, from Seattle to Southern California, and the metropolitan New York area. Distribution throughout the rest of the country will remain undisturbed.

Industry People...

Rein Narma, formerly vice-president of Fairchild Recording Equipment Corporation, has joined the Ampex Professional Products Company as manager of engineering for the Audio Products Division. He will be responsible for advanced audio development, new product design, and technical services . . . **Henry Berlin,** formerly assistant sales manager, has been promoted to the new position of marketing operations manager for Telectrosonic Corporation.

George J. Saliba, former president of Presto Recording Corporation, recently retired from active duty after 27 years with the company. His recent responsibilities as the company's government contract administrator are being assumed by **Theodore Karlin** . . . The industry's best wishes go to **Henry Goldsmith** as he diversifies the activities of Rigo Enterprises, Inc., to take on the national sales distribution of the new line of Clemetsen hi-fi equipment and speaker cabinetry . . . **Arnold Singer** is the newly-appointed advertising manager of Pilot Radio Corporation, replacing **Ira Joachim** who has resigned. Mr. Singer has a wide background in advertising, and was most recently with Smith, Greenland Company, New York agency.

Nat Welch, widely known in the audio industry through his long-time association with ORR Industries, manufacturers of Irish brand magnetic tape, has formed a firm known as Nat Welch, Business Development, devoted to encourage the development of new small manufacturing firms in Alabama . . . **John P. Taylor,** veteran RCA advertising executive, has been appointed to the new post of manager of marketing administration, Broadcast and Television Equipment Division . . . **William Djinis,** formerly senior project engineer of Reeves Instrument Corporation, has been named chief engineer in charge of all scientific activities of Electro-Sonic Laboratories, Inc., makers of ESL cartridges.

ADVERTISING INDEX

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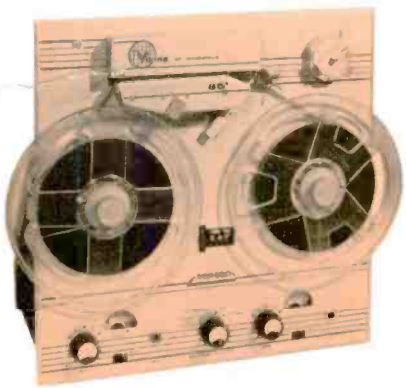

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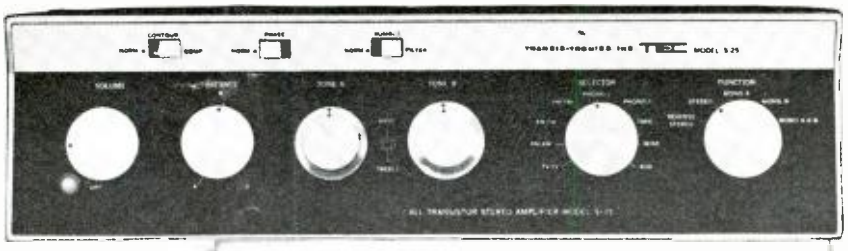

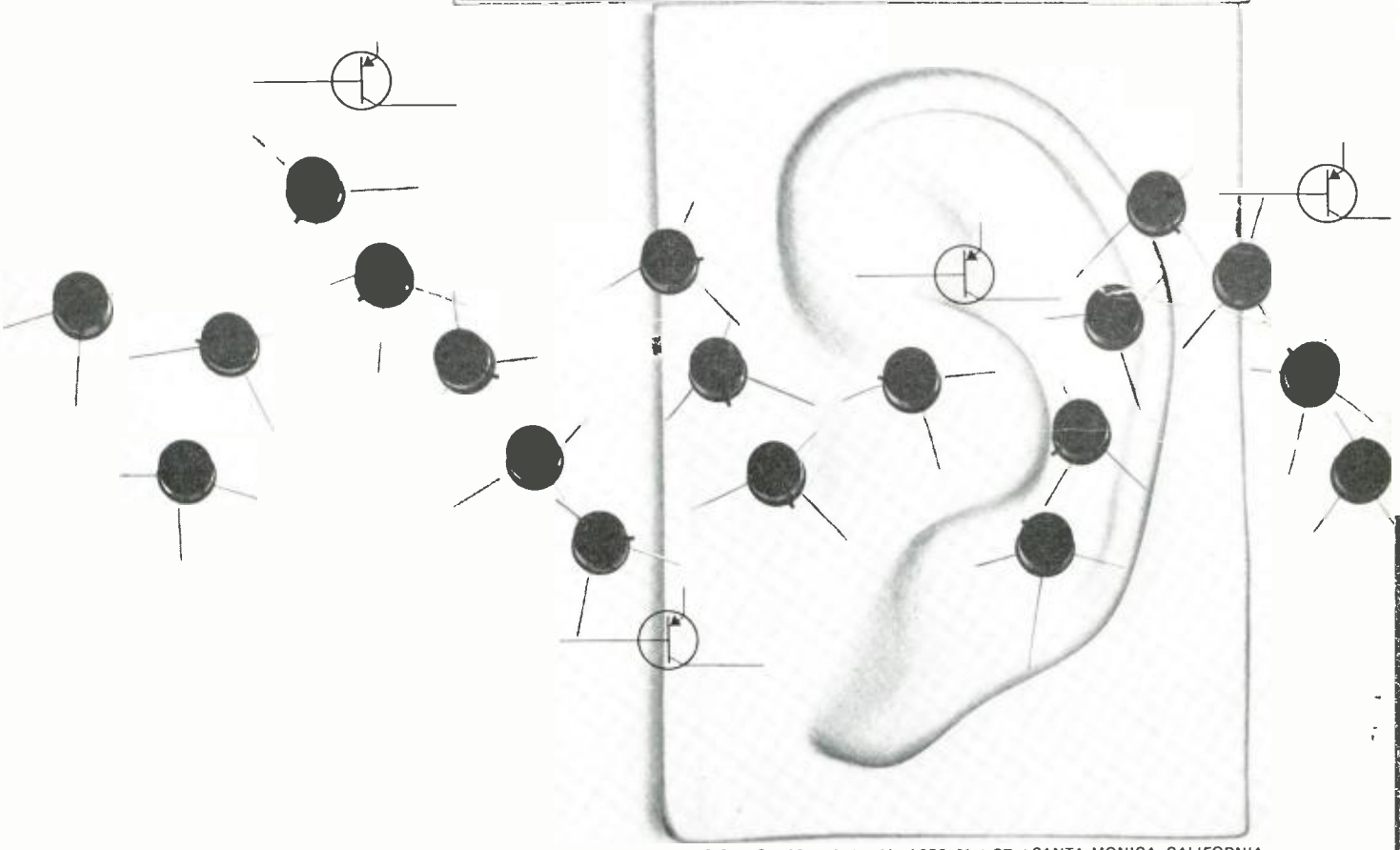

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