AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

NOVEMBER, 1955

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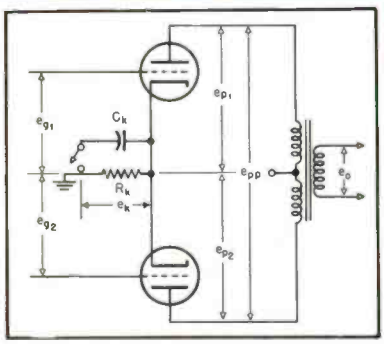
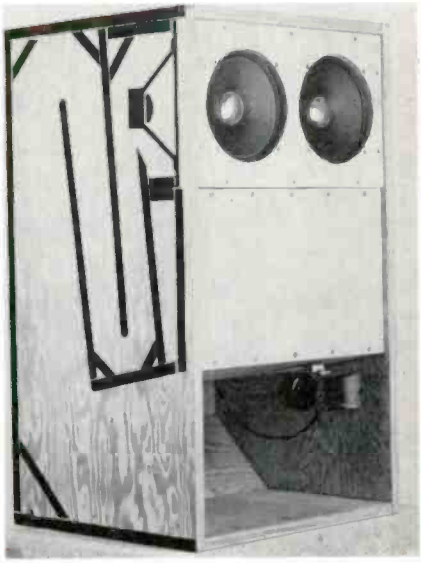
AHC



Wondering about the need for a capacitor across the bias resistor of a p-p output stage? See pg. 21



Easily constructed housing for two 8-inch speakers provides exceptionally fine quality. See page 17.

THE CONSTANT WIDTH FOLDED EXPONENTIAL HORN

USES AND ABUSES OF THE VU METER

LA ALTA FIDELIDAD IN MEXICO

DESIGN OF BIFLEX LOUDSPEAKERS

You may interpret this picture in many ways—but music is interpreted by University in only one way... *faithfully*. For information about the speaker systems shown above, please send for Free illustrated brochure A78.

UNIVERSITY LOUDSPEAKERS, INC., WHITE PLAINS, N. Y.

Photo by Ray Cicero. Instruments courtesy of Henry Adler Music Co., N.Y.C.

THE BRITISH INDUSTRIES

Sounding Board

Were you there

at the Carnegie Hall Concert-Demonstration by G. A. Briggs?

May we ask a favor?

As you know, the Briggs Concert-Demonstration was virtually sold out. Newspaper columnists and others have been highly complimentary. For example . . . the New York Times said: "From the audience's enthusiasm, it appears that many were experiencing a new dimension in sound reproduction. Although the engineers have not yet achieved absolute fidelity, they are getting there." The New York World Telegram called it "A stupendous demonstration of how far hi-fi has travelled in achieving the illusion of live music."

You can imagine how gratified we are to have had the pleasure and the honor of co-sponsoring this outstanding event. We admit that before the program, we were quite concerned about attendance . . . for we had no reason to believe that the program would have appeal here simply because it had been successful in England.

Now, having "come through" in our efforts, because of your interest, we are receiving a great deal of mail . . . and we are struck by the variety of reactions expressed by those who attended. For example, we now discover that some of the audience could not hear Mr. Briggs' lecture very easily, although they heard the music perfectly. In other words, the acoustics of the auditorium evidently were playing some tricks on the Carnegie Hall public address system.

Quite a few people have written suggesting that we sponsor other similar demonstrations in various parts of the country. It was such suggestions that caused Mr. Briggs to decide to undertake the Carnegie Hall project at the time when his London Festival Hall demonstrations were heard by Americans who thought he should repeat them in New York.

Therefore, we would now like to ask a special and important favor of you. Will you please send us your frank comments on the Briggs Demonstration? That is the favor we are asking . . . and we will probably base many of our future plans on the personal reactions you express.

Just use the reverse side of this page for your comments. The page is perforated . . . tear it out, and mail to us in an envelope. We will greatly appreciate the few minutes of time you give to this.

Sincerely yours,

Leonard Carduner

PERFORATED FOR YOUR CONVENIENCE IN CUTTING THESE OUT AND SAVING THEM.

The Sounding Board

The Soundboard

TEAR OUT AND MAIL TO:
British Industries Corporation
80 Shore Road
Port Washington, New York

Gentlemen:

I ☐ did attend ☐ did not attend the Briggs Concert-Demonstration at Carnegie Hall and would like to make the following comments:

1. I sat in ☐ a first tier box ☐ the parquet ☐ a second tier box ☐ dress circle ☐ balcony. My seat was ☐ left ☐ center ☐ right.

2. I heard Mr. Briggs' spoken lecture ☐ well ☐ adequately ☐ poorly from my seat.

3. I heard the musical demonstration ☐ well ☐ adequately ☐ poorly from my seat.

4. My opinions are as follows:

(Please carry over on another sheet if you do not have enough space)

Name .....

Address .....

City .....

Zone ..... State .....

Thank you for your comments, on behalf of the British Industries Group, consisting of the following products:

B I C ENDORSED QUALITY

Garrard Record Players
Leak Amplifiers
Wharfedale Loudspeakers
R-J Enclosures
River Edge Cabinets
Genalex Tubes
Ersin Multicore Solders.

NOVEMBER, 1955 VOL. 39, No. 11
Successor to RADIO, Est. 1917.

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

CONTENTS

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

AUDIO PATENTS

RICHARD H. DORF*

STEREOPHONIC SOUND has been becoming popular to a certain extent, since it does give more realistic sound. One of its problems is the requirement for at least two and, better, three transmission channels. In motion picture work, for example, this is practicable for Cinemascope films since they must be run through specially equipped projectors anyway because of the requirement for anamorphic lenses, and provision of the sound pickup equipment to take care of multiple channels is only incidental. However, standard films could also be enhanced by stereophony, especially on today's wide screens. In this case, a film normally printed with three tracks for sound could not be run on a normal projector and a separate print would have to be available for unequipped houses. The two systems would not be compatible.

C. Robert Fine of Tomkins Cove, N. Y., has invented a system which can be compatible, and at the least employs only two sound tracks for the equivalent of three sound channels. The patent number is 2,714,633.

Figure 1 is a block diagram of the transmission or recording system. The audio signal from a pickup or microphone of the normal type is connected to recorder 1 and is recorded on sound track 1 in the usual way. A second recorder and track are provided into which three oscillator signals may be mixed, designated as f_a, f_b, and f_c. Each of these oscillator signals has a gain control and volume indicator as shown, and an operator controls them so that if one is assigned to the right, another to center, and the third to left, the comparative levels will correspond to placement of a sound. Maximum level on the left oscillator, medium at the center, and minimum at the right, for example, would correspond to placement of the sound near the left of the area.

Figure 2 shows the reproducing equipment in a theatre equipped for the system. Pickup 1 takes sound from track 1 and feeds it to the input of three control amplifiers. The output of each of these feeds a power amplifier and speaker, the three speakers being distributed about the stage with one at left, one at right, and one in the center.

Pickup 2 takes control signals from track 2, feeding them to the inputs of three bandpass filters. Each filter passes only one of the three control signals to a rectifier and thence to one of the control amplifiers.

Each control amplifier has a gain which is proportional to the amplitude of its control-frequency signal. While the same sound is fed to all three speakers, the comparative levels in the speakers, controlled by the operator during recording, determine the effective source of sound.

Some modifications are possible. If it is not possible to put track 1 on the film at the normal place so that an unequipped projector can handle the film simply by ignoring track 2, the whole thing can be put on one track, simply by using frequencies above or below the normal band of audio transmitted and keeping the maximum control-signal level well below the normal sound level. It is also possible to control the amplitudes of the oscillator signals of *Fig.* 1 automatically so that no operator is necessary. To do this, three microphones are used. The sounds from all of them are mixed and fed to recorder 1. A separate signal is also bridged from the

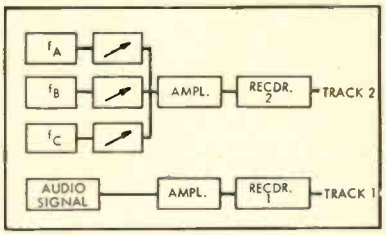


Fig. 1

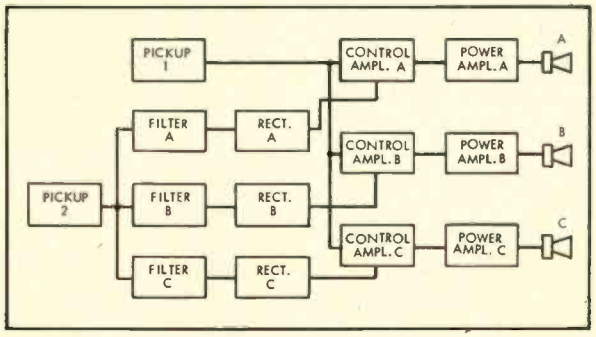


Fig. 2

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

GARRARD
World's Finest

now presents its new

MODEL 301
"the Professional"
transcription turntable

MODEL 301
Transcription Turntable **$89.00 net**

WHY RECOMMENDED: This machine has been designed to provide the professional user and quality enthusiast with a unit supreme in its class . . . truly the world's finest transcription turntable for use in the home!

FEATURES:

1 TURNTABLE: 12" diameter . . . 7½ lb. cast aluminum . . . dynamically balanced, and precision-machined. Permanently "true" center boring fitted with phosphor bronze bushing.

2 NEW HEAVY-DUTY MOTOR: 4-pole shaded design, specifically engineered for this unit. Entirely Garrard-built heavy die-cast housing. Dynamically balanced armature. Rotor set into permanently accurate, self-centering, self-lubricating phosphor bronze bushings.

3 FREE-FLOATING ISOLATED MOTOR MOUNT: A newly developed GARRARD principle, whereby the entire motor is suspended in air by two sets of counterbalancing tension springs. This unique mounting eliminates even the barest possibility of vibration being transferred to the unit plate.

4 NOISELESS MAIN SPINDLE: Rotates on single, specially designed frictionless semi-elliptical bearing of phosphor bronze which eliminates noise and rumble and is simple and inexpensive to check and replace.

5 BUILT-IN PRESSURE LUBRICATING SYSTEM: Oversized grease-housing permanently mounted on main spindle to insure continuous, proper lubrication at all times. Knurled knob, easily accessible from top of unit for turning, forces additional lubricant into spindle, when required.

6 VARIABLE SPEED CONTROL: Simple, foolproof eddy current brake permits instantaneous variation of all 3 speeds. Positive action at all times through permanent magnet, which interacts with revolving metal disc. No friction, no loss of efficiency.

SPEED SAFETY LOCK: Makes it mandatory to shut unit off before switching speeds. An important safety device, preventing jamming of idlers and operating mechanism.

7 RESISTOR-CONDENSOR NETWORK: Eliminates shutoff noise, which is normally induced through pickup to loudspeaker.

PERFECTED TURRET-DRIVE MECHANISM: Large, true pulleys actuate oversized live rubber interwheel, which is mounted on ball bearings and retracts upon shutoff.

SHUTOFF BRAKE: Stops free turntable revolutions when unit is switched off.

8 EXCLUSIVE MOUNTING—SUSPENSION SYSTEM: Permits unit to be mounted firmly to motorboard in fixed relationship to tone arm. Entire motorboard (including turntable and tone arm) is then spring-suspended on base. Special conical Garrard springs and other hardware provided.

9 HEAVY UNIT PLATE: Entirely die-cast aluminum.

SPECIFICATIONS: Voltage: Dual range, 100 to 130 and 200 to 250 volts, 50 cycle pully available. **Wow:** Less than 0.2% **Flutter:** Less than 0.05%. (Gaumont—Kalee Wow and Flutter Meter Type 564) 3000 cycle constant frequency records at 33⅓, 45 and 78 rpm. **Rumble:** Virtually non-existent. **Cabinet space required:** 16" back to front x 13¾" wide x 2⅝" above (excluding pickup) and 3½" below top of motorboard. Weight: Net 16 lbs., Gross 20 lbs.

INDIVIDUAL INSPECTION REPORT and owner's manual: Great attention has been given to quality control details appreciated by the connoisseur; including the most exhaustive performance test-procedure ever devised by a gramophone manufacturer. Accurate measurements of speed, wow, flutter, rumble, flash and insulation are contained in an individual inspection card, enclosed with each Garrard Turntable and referring to that turntable *only*. Also furnished are a comprehensive 24 page book-bound owner's manual and a permanent, heavy-duty strobescope.

Typical installation on base with a popular tone arm.

B.I.C. ENDORSED QUALITY

A quality-endorsed product of the British Industries Group:
- GARRARD Record Players • LEAK Amplifiers
- WHARFEDALE Loudspeakers • R-J Enclosures
- RIVER EDGE Cabinets • GENALEX Tubes
- MULTICORE Solders

Write for illustrated B.I.C. High Fidelity Plan Book . . .

British Industries Corp., Dept. A-115
Port Washington, New York

Please send B.I.C. High Fidelity Plan Book.

Name_____
Street_____
City_____ Zone____ State_____

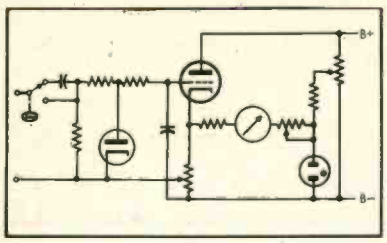


Fig. 3

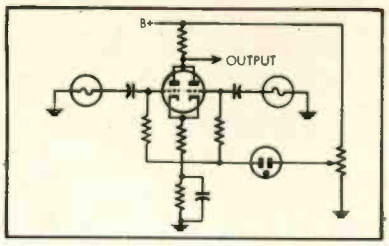


Fig. 4

output of each microphone (or microphone preamplifier) and fed to three rectifiers. Each rectifier will then provide a d.c. voltage of level corresponding to the average level of audio from its microphone; and these three d.c. signals may be used to control the amplitudes of the control signals automatically.

Vacuum-tube Voltmeter

In Patent No. 2,713,663, John R. Cabbe discloses a simple vacuum-tube voltmeter whose special virture is a linear scale for low values of measured voltage. The invention is assigned to Servo Corporation of America; the circuit is shown in *Fig.* 3.

The triode is connected as a cathode follower, the output signal appearing at the cathode. One end of the meter is connected to the cathode through one fixed multiplier resistor and one variable zeroing resistor connects the other end of the meter to the top of a neon lamp whose function is to provide a stable reference voltage, which it does acting as a gaseous regulator. Under no-signal conditions the tube cathode is at the same potential as the reference. When a signal is applied to the grid, d.c. level at the cathode changes and the difference between it and the referenc voltage appears on the meter.

The linearity of readings is occasioned by the fact that the amplifier is biased in the center of its linear area, this bias being adjustable during calibration by the arm on the cathode resistor. This being the case, output should be linear with input at any level up to a certain maximum, since it is differential rather than absolute level which is being read. The rectifier and input switch allow for the measurement of a.c. voltages by rectifying them and filtering through the following resistor and shunt capacitor.

Zero Beat Indicator

Aural frequency comparison when two frequencies must be matched is not the most accurate method. James M. Lawther has invented and assigned to the U. S. government a zero beat indicator which is simple and may be handy for certain applications. The patent number is 2,715,699.

The circuit appears in *Fig.* 4. One of the two signals to be compared is fed to the grid of each section of a duo-triode tube. The mixed signal at the cathode appears across both series cathode resistors and the signal at the junction is fed to one electrode of a neon lamp. The other electrode is connected to a power-supply bleeder with the tap adjusted so as to place across the lamp a voltage about halfway between the lamp's striking and extinction voltages. The beat between the two signals, if it is below the visible flicker rate of about 25 cps, causes the lamp to flicker and the frequencies may be adjusted to zero beat by observing that the lamp ceases to flicker. The capacitor across the lower cathode resistor bypasses frequencies higher than 25 cps.

Anyone who wants to examine a patent may get a copy by sending 25 cents to The Commissioner of Patents, Washington 25, D. C.

Employment Register . . .

Positions Wanted and Positions Open are listed here at no charge to industry nor to individuals who are members of the Audio Engineering Society. Positions Wanted listings from non-members are handled at a charge of $1.00, which must accompany the request. For insertion in this column, brief announcements should be sent to AUDIO, P. O. Box 629, Mineola, N. Y. before the fifth of the month preceding the date of issue.

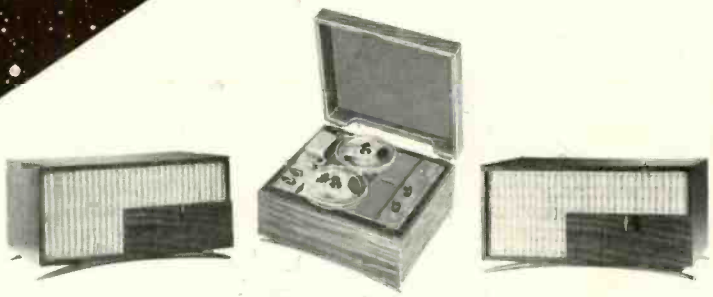
• **TECHNICAL EDITOR.** Five years experience writing, also editing of technical data sheets and instruction books for leading eastern audio manufacturer. Supervision of layout and Multilith work. Some military instruction book experience. Attended Technical Writers' Institute. Desire position with manufacturer to take charge of technical publications for audio products. Box 1101, AUDIO.

• **RARE OPPORTUNITY** in High Fidelity business! Established custom high-fidelity laboratory in southern Connecticut has outgrown one-man ownership. Additional national distributor appointments now greatly increase profits. To the right man with small capital to invest, a sincere interest in the Audio field and time to devote to the business, there is a truly unusual opportunity. Write Box 1102, AUDIO.

• **AN EXPERIENCED SOUND SALESMAN** is wanted by one of America's most successful and respected dealers in high-fidelity equipment. Located in the New York area within easy commuting distance of New Jersey and Connecticut. The man we want must be stable and capable. The job we offer carries both security and good earnings. If you enjoy selling and are competent in your knowledge of hi-fi gear, tell us about it in a note to Box 1103, AUDIO.

GIVE AN AMPEX

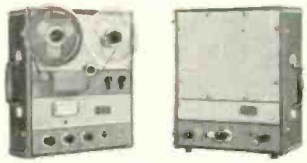
for a once in a lifetime Christmas



EXCITING STEREOPHONY RIGHT IN YOUR LIVING ROOM

THE AMPEX 612 STEREOPHONIC SOUND SYSTEM

Overwhelming! The startling realism of true stereophonic sound that only a superb tape machine can provide. And what a gift for the family. The 612 achieves vivid reproduction . . . music that seems to have actual presence right in the living room. It plays full and half track tapes too. Complete Stereophonic Sound System, in custom designed cabinets, is priced at $699 — a lasting investment in listening and enjoyment.



SUPERB RECORDING ANYWHERE

THE AMPEX PORTABLE 600 & 620

Perfect! For the discriminating music lover . . . hi-fi fan . . . professional musician . . . or talented youngster, the Ampex 600 is the finest tape recorder you can give. Its brilliant tone and precise pitch combine with rugged construction for years of trouble-free performance. The 600 costs $545. The matching 620 Amplifier-Speaker is priced at $149.50. Together, in handsome Samsonite carrying cases, they form a complete integrated system — portable perfection in sound.

AMPEX CORPORATION

Distributors in principal cities (see your local Telephone Directory under "Recording Equipment.") Canadian distribution by Canadian General Electric Company.

SIGNATURE OF PERFECTION IN SOUND

934 Charter Street, Redwood City, California

NEW LITERATURE

• **G & H Wood Products Co., Inc.,** 99 N. 11th St., Brooklyn 11, N. Y., makers of Cabinart speaker and equipment enclosures, has adopted an interesting approach to the cataloging of its cabinetry with the introduction of four handsomely-designed folders. Folder 1 is concerned with Cabinart fine-woods cabinets and assembled, ready-to-finish equipment cabinets. Folder 2 is devoted to kits. Folder 3 details the latest Rebel horns and the new Rebel Ortho speaker systems. Folder 4 is a not-too-technical discussion on wall storage cabinets and cabinet kits. Copies of the folders may be obtained from Cabinart dealers, or will be mailed free upon request to the manufacturer. **V-1**

• **Livingston Electronic Corporation,** Livingston, N. J., lists picked tapes from the libraries of twelve labels, including a large variety of two-channel stereophonic selections, in a new master catalog of prerecorded tapes available in the Livingston Master Tape Treasury. Material ranges from Latin-American music, Dixieland, and Popular to full symphonic works. Labels represented include Atlantic, Boston, Audiosphere, Esoteric, Hack Swain, Oceanic, and others of similar prominence. For the time being all releases are limited to a speed of 7.5 ips in order to insure best performance of the greatest number of available equipments. Ultimately, the catalog will include 3.75-ips releases when such coverage is justified by equipment availability. **V-2**

• **Weston Electrical Instrument Corporation,** 614 Frelinghuysen Ave., Newark 5, N. J., illustrates and describes its complete line of test equipment in new catalog R36A. Included are all instruments for servicing TV, radio, and other communications equipment, as well as industrial electronic and electrical equipment. Also described is the new Weston simplified method of visual alignment, an accurate and money-saving procedure for servicing TV receivers. Copies of the catalog are free, direct from the manufacturer. **V-3**

• **CGS Laboratories, Inc.,** 391 Ludlow St., Stamford, Conn., graphically details the various steps necessary in processing a patent application in a new 20-page booklet which is being offered without charge to the engineering profession. The booklet is titled "Preparing for Patent-Hood," and was written by Elton T. Barrett, CGS Laboratories president, who for many years was a practicing attorney in New York. Professional engineers may obtain a copy by writing to the address shown above. **V-4**

• **Telectro Industries Corp.,** 35–18 37th St., Long Island City 1, N. Y., describes and illustrates in considerable detail the firm's facilities for design and manufacture of electronic and electro-mechanical devices, in a new 24-page booklet which will be mailed on request. Also covered are some of the company's products, including tape and wire recorders, precision signal generators, public-address systems, inter-com systems and photographic dryers. A special section of the brochure is devoted to Telectro's new encapsulation techniques for transformers and high-voltage power supplies. **V-5**

• **Magnecord, Inc.,** 1101 S. Kilbourn Ave., Chicago 24, Ill., has announced publication of a booklet which defines 207 valuable uses for a tape recorder in today's modern living. It segregates the 207 uses into classifications such as professional, educational, church, business, recreation, etc. The booklet also illustrates the simplicity of recording and playing back, and gives tips on methods for preserving and using tape recorders for best results. Requests for copies should be directed to the Advertising Department at the address shown above, and must include a remittance of twenty-five cents. **V-6**

FOR THE MAN WHO DEMANDS THE FINEST...

For the man who wants a high fidelity system of truly professional quality built into his home, Altec is proud to offer this outstanding group of integrated components. This 30 to 22,000 cycle high fidelity system reflects fully the faultless performance for which Altec is renowned. In addition Altec's consultant service will provide the assistance in installation planning that will assure your enjoyment of the full potential of your Altec Lansing home music system.

The high fidelity system illustrated is available from better high fidelity outlets. Outstanding Altec systems are priced from $324 to $1009.

ALTEC FIDELITY IS HIGHEST FIDELITY!

ALTEC®
LANSING CORPORATION

Dept. 11-A
9356 Santa Monica Blvd., Beverly Hills, California
161 Sixth Avenue, New York 13, New York

loudspeakers • reproducers • amplifiers • preamplifiers • tuners • enclosures

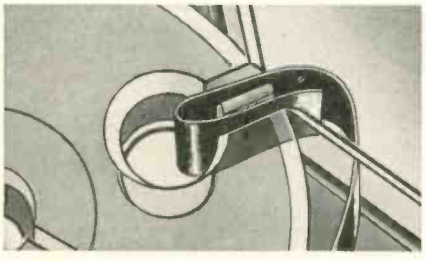
Now! Take your

Famous acetate-backed "Extra Play" Tape 190—new economy price saves you 28%

Here's your chance to buy the magnetic tape everyone's talking about—at a special *new economy price!* It's popular "SCOTCH" Brand "Extra Play" Magnetic Tape 190, first long play tape on the market and *still* the best seller. With 50% more recording time on every reel . . . higher fidelity . . . strength to spare . . . high potency oxide . . . "SCOTCH" "Extra Play" Magnetic Tape 190 has been making recording history. Buy now and save 28% on every reel!

Both these SCOTCH BRAND *Magnetic Tapes*

REG. U.S. PAT. OFF.



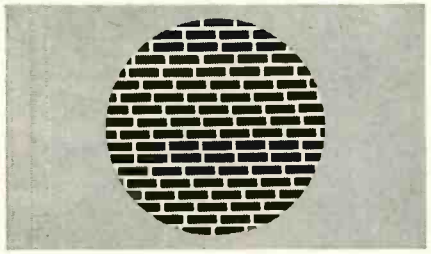
EASIER THREADING with new "Loop-Lok" reel! Saves time... saves tape! It's "SCOTCH" Brand's exclusive "Loop-Lok" reel. Just loop tape around the new-design center pin for instant threading. Tape locks tight without necessity of troublesome wrap-around, yet releases fast at end of reel.

choice of backings

New polyester-backed (Made from DuPont's "Mylar"*) "Extra Play" Tape 150 for extra strength

Years ago "SCOTCH" Brand pioneered tough polyester-backed magnetic tape for experimental government orders. Now *you* can enjoy the *same* benefits of "SCOTCH" Brand research and development with new "Extra Play" Magnetic Tape 150. "SCOTCH" Brand's extra-strength polyester backing assures you long-lasting recordings . . . perfect tape performance in all weather, all climates—(It's "Weather-Balanced"!)

feature "Loop-Lok" reel and high-potency oxide!



CRISP, BRILLIANT SOUND thanks to newest oxide coating! By laying fine-grain oxide particles in a neat, orderly pattern (as shown here), "SCOTCH" Brand is able to pack in thousands more particles than standard long play tapes —to produce a super-sensitive magnetic recording surface.

*"*Mylar*" *is a registered Du Pont trade-mark.*

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

LETTERS

Sealed Records

SIR:

In a recent issue (June, 1955) Mr. Canby referred to his mention of sealed records about two years ago, and we recall that at that time he brought up the analogy of milk, a product sold in containers so the one we buy is surely not one that was tasted by another prospective purchaser. He also mentions the present condition of sealed records which—in many instances—can be opened and resealed. In other words, they are records in not only a plain cardboard jacket but also with removable underwear.

During the past two years, records have been shipped—by at least one manufacturer—in plastic bags under the regular cardboard jackets, and the bag was heat sealed so it could only be opened by cutting the sealed part off with a pair of scissors. The purpose of the plastic bag *inside* the jacket was to provide a fairly tight covering over the record so that if it slides inside the cardboard during shipping, the plastic would get scratched instead of the record. Tests showed this protection was very effective. The heat seal ensured the buyer an unplayed, unscratched copy. It did not ensure a copy without manufacturing defects inasmuch as these cannot always be detected by visual inspection, and the manufacturer cannot play every disc.

This type of packaging was introduced in the summer of 1954, and it was followed by a steady drop in sales for the whole catalog, as well as complaints from customers who refused to buy records without first listening to them and by retailers and distributors to the same effect. The percentage of returned discs increased tremendously, although many of the discs returned showed no more defect than an occasional scratch which could only have been inflicted on it after the opening of the bag. The only explanation of this phenomenon about returned merchandise that was found was that since people could not listen to records *before* they bought them, they listened to them *afterward*, and if they did not like the music (and who can be expected to like *all* music!) they returned the records to the store. Since the seals were broken, the store had to send these discs back to the manufacturer in played, scratched, and unsaleable condition. As it turned out, two records had to be made in order to sell one, and the 5 per cent margin of profit does not allow this. No similar condition existed before the records were sealed.

If Mr. Canby were a manufacturer, what would he do? Only two choices seem to be available—increase the price of the product to make it possible to absorb the cost of the returned discs or stop sealing the records. In this case the latter was chosen.

I am sure other manufacturers have analyzed this problem, even though they may not have tried out the sealing for themselves. It is a serious problem, for Vinylite is as soft as butter compared with a worn sapphire 1-mil stylus as it is normally available in listening booths when handled by the shaking hands of those who rushed in to make a purchase. The almost indestructible (except breakable) 78-rpm discs are gone. If the public were willing to accept it, I am sure the manufacturers would be only too glad to provide a "sanitary" disc—it was tried and the public said no.

PETER BARTOK,
Bartok Records,
113 W. 57th St.,
New York 19, N. Y.

LOTS and lots of tuners around these days.
Some must be better than others.
But how do you know which is best?
You listen. You compare. And your eye and ear will tell you plainly . . . National's Criterion.
What you hear is true high-fidelity . . . the lowest over-all distortion of any popular tuner on the market—less than 1% for full 75kc deviation on all signals above 4 uv.
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Best-frequency response on AM, too (less than 2 db down at 5 kc). Meaning true high-fidelity not only on FM but on AM as well.
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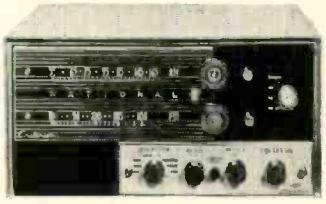

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Likes Less Dynamic Range

SIR:

For years, Mr. Canby's RECORD REVUE has given thorough reports on records, but they are almost always "classical." I, too, was a classical hound for many years. I abhorred the lighter music such as "Oklahoma," etc, and jazz was just out of my listening realm.

However, I finally woke up to one thing. When I played records, others had to hear them too. It was the effect on them that should reflect in satisfaction to me. When playing a classical record with bombastic moments, I would be asked to turn the volume down (*Where have we heard that before?* ED.) and when I did, the quieter portions of the record were hardly audible. There was something wrong—my friends would rather talk than listen to these records. It couldn't be the equipment, for it is of fairly high quality, involving many dollars and around 25 years of audio activity.

I finally concluded the music others wanted to hear was of a more even volume level and selections with which they were somewhat familiar. I have disposed of all of all my classicals and gone entirely over to the lighter types of music. Now my friends go through the stack of records eagerly and ask for many of them to be played. Why? Because they are familiar with these numbers—when played, they will listen, and often hum or sing with the music.

Moral: Give people the type of music they like and they will enjoy it. Too few people are sufficiently musical to enjoy and appreciate the classicals.

ADOLPH HOEFER,
8330 Kingsbury Blvd.
Clayton 24, Mo.

Putting Hi-Fi House in Order

SIR:

At last it has happened. We've waited a long time for this one. Sam Goody is a genius for writing it and you are a hero for publishing it.

As the AES Annual Report of a few years back succinctly stated, if we don't put our (Hi-Fi) house in order, they (the nonprofessionals) will do it for us. Let us all bow our heads in reverent silence for one minute while we give thanks to Mr. Goody for making the first dose so palatable.

And now that the ice has been cracked may I ask volunteers to join a society in favor of requiring all magazine publishers to require all authors and all advertisers to submit complete performance data or their manuscripts, copy, etc. will be rejected.

And may I offer as a suggestion to both authors and publishers that all graphs of performance of something *vs.* frequency be plotted either as volts, amps, watts, etc. *vs.* frequency on logarithmic coordinates or with db *vs.* frequency on semilog paper using a scale in which 20 db equals one decade on the frequency scale. (*Sorry,* AUDIO *has always used 20 db per decade.* ED.)

We all know what 6 db per octave means, and we know that it has a 45° slope. When some joker publishes a transducer curve with either a warped frequency scale or a cramped db scale, it is, to say the least, misleading.

Three cheers, anyhow, for starting the new bandwagon in high gear.

BENJAMIN B. DRISKO,
25 Fottler Road,
Hingham, Mass.

NOW HEAR THIS...

for improved high fidelity

GOODMANS

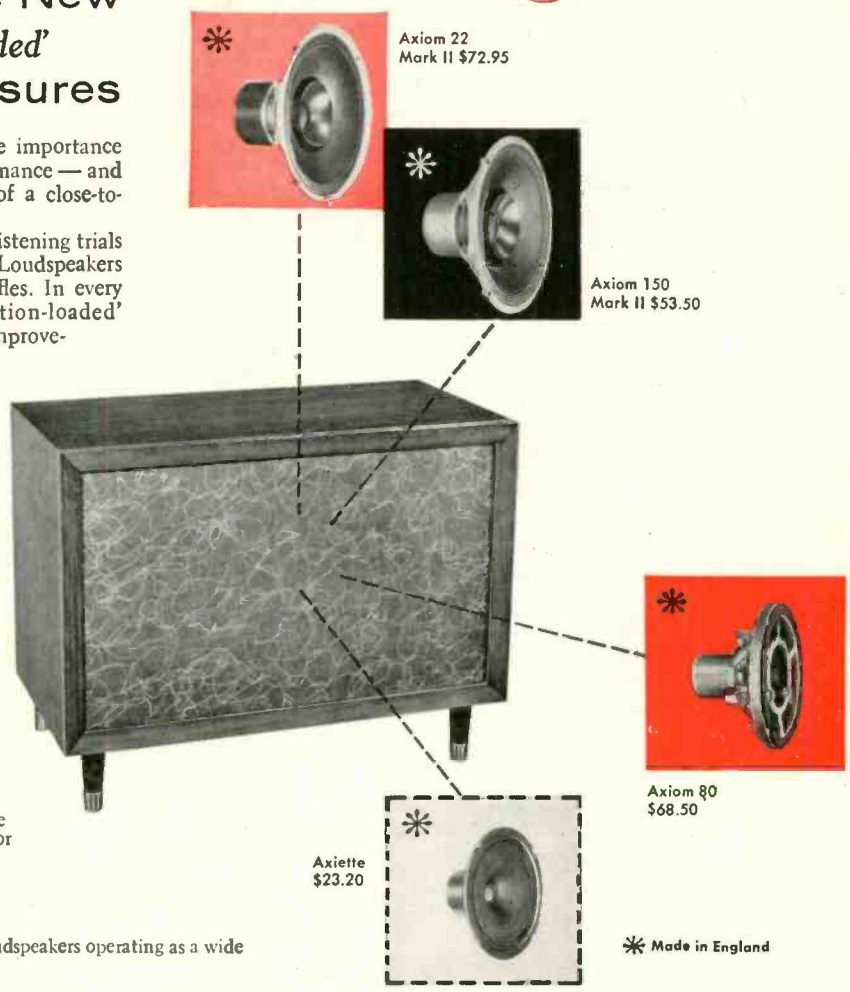
LOUDSPEAKER SYSTEMS

featuring the New *'Friction-Loaded'* Axiom enclosures

We have always stressed the importance of the baffle to loudspeaker performance — and now we have the ideal example of a close-to-perfect combination.

Actual comparison tests and listening trials were conducted with Goodmans Loudspeakers mounted in different types of baffles. In every instance, the new Axiom 'friction-loaded' enclosures produced a marked improvement in sound quality. It appears that this design brings out the full inherent performance of the loudspeaker.

Friction loading is an entirely original principle. It was developed by a famous British physicist while working on an acoustical project for Goodmans Industries. At present, there are four enclosure designs available:



MODEL 180
— for use with a single wide range Axiom 80 loudspeaker.

MODEL 172
— for use with a single wide range Axiom 22 or 150 loudspeaker — or an Audiom 12-inch 'woofer' with an Axiette or Axiom 80 as a two-way system.

MODEL 280
— for use with two Axiom 80 loudspeakers operating as a wide range single system.

MODEL 480
— for use with four Axiom 80 loudspeakers operating as a wide range single system.

Prices slightly higher on west coast

Complete do-it-yourself construction details are available, and will be furnished on request.

For complete information, write to Dept. OL-1

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EDITOR'S REPORT

1955 AUDIO FAIR

THE BIGGEST AUDIO event of the year has just ended and—in our opinion—it was the greatest to date. Some of the more jaded audiofans were heard to say that there was nothing new—just different models of the same old amplifiers, tuners, loudspeakers, and so on. But that is just what makes an audio show so interesting—there *are* different models, literally hundreds of them that are the result of thousands of hours of planning, styling, engineering development, and just plain hard work. True, there weren't hundreds of radically new items, but on the whole the manufacturers are to be congratulated on the showings they made. Pickering's new low-crossover condenser "tweeter" deserves special notice because of its "window on the studio" quality. Though we have long been familiar with the smoothness of the Janszen, which crosses over at 1000 cps, the new unit which crosses over at 400 cps gives us an idea of what to expect from full-range condenser loudspeakers—several units of which are under development. Perhaps that's for next year.

There is always enough of interest to keep anyone busy at an audio show—four days hardly seem enough to see everything. And to those of us who go to all the shows—which may be construed as either a privilege or a duty, depending on one's interest in audio—something new will always turn up.

Regrettably, Boston came too late in October to be reported here. But next month comes Philadelphia and Mexico. Our spies will have to cover Philly—we're going South—'way South. Nothing is ever quite so interesting as the first audio show in a city which has not been favored with one before.

Exhibitors at the Philadelphia Hi-Fi Show, November 4–6, may be found at the Benjaman Franklin Hotel where their products may be seen and—best of all—heard. The thirty-six exhibitors at the First Mexican High Fidelity Fair may be found at the Hotel Reforma in Mexico City, same days. We have already seen the program for that event, and it is striking and most unusual.

THE BRIGGS CONCERT

Regardless of its official name, the concert staged by Gilbert A. Briggs with the collaboration of P. J. Walker in Carnegie Hall on October 9 is now known to New York audiofans as the Briggs Concert. In many respects this lecture-concert was a revelation to those who attended, because the similarity of the original sound to that reproduced via tape or record, amplifiers, and loudspeakers was surprisingly close. Not that one couldn't tell the difference, naturally, but many of those who criticize reproduced music as being completely inadequate in comparison to the original performance should better have been in Carnegie Hall that afternoon to see just how good our modern audio equipment really is.

For the earlier portions of the concert, this observer was seated in the third row—a position that placed the string quartet only about two-thirds of the distance from listener to loudspeaker. This made a difference in level on the material involving quartet and tape of what we would guess to be 2 db. The added closeness made the oboe seem brighter live than recorded, though it is possible that it may have been so anyhow. At the average listener's distance from the stage, the difference between the distance to musicians and to loudspeakers would have been a much smaller percentage, and would undoubtedly have been unnoticed. In fact, it is assumed that when the levels were set the engineers were somewhat further from the stage than this listener was.

A second fault observed was the phase differences from the four speakers—only one or two were used for the quartet and piano numbers—since the differences in distances were appreciable in the third row. However, since most of the audience seemed to be enjoying the music greatly, it was felt that a change of seat might make a difference, and we moved back to the twentieth row. There the levels were comparable, and the phase difference from the four speakers was eliminated, and, in fact, the differences between live and reproduced sound were much less. In our opinion, reproduced music came off very well at this concert, and many doubts should have been dispelled at the results.

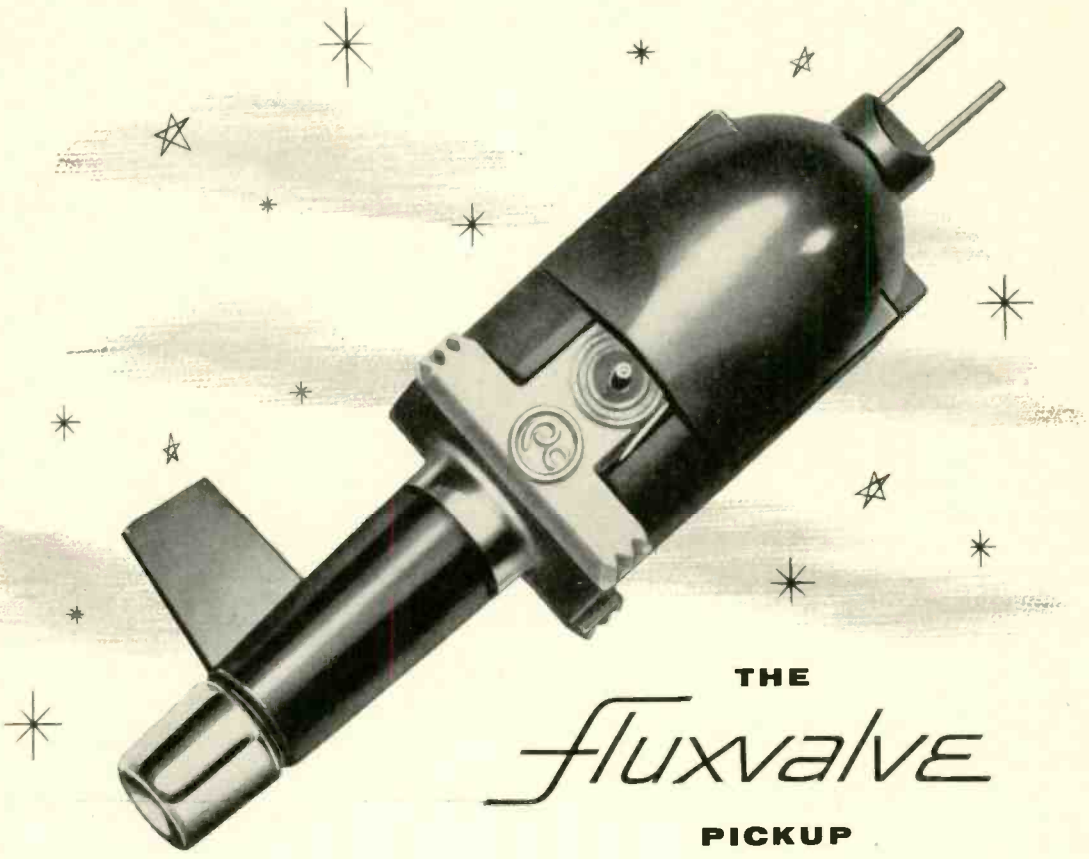
Some 2600 people were in attendance, and since Carnegie Hall seats only 2760, it may be considered a sell-out—only a few seats in the top balcony were unoccupied. Mr. Briggs' droll Yorkshire wit was called charming, delightful, and entertaining, and on the whole the event was a milestone in U. S. audio history. Mr. Walker concluded the afternoon with a short technical description of the equipment used—and this talk was expanded into the article beginning on page 30.

We feel that one of the most important points in the entire demonstration was the showing of instantaneous power requirements for various types of music. There were many times when the total exceeded 60 watts, and even then the reproduced sound never seemed too loud for the hall. Now we are toying with the idea of reproducing the power level indicator for our own education.

AUDIO CANADA

Off to a latish start, but off, nevertheless. The Canadian insert, that is. And just after getting it under way, our editor for Canada collects himself some germs or virii (if that's the plural of virus) at the New York Audio Fair. We trust we shall resume the AUDIO CANADA insert for our Canadian readers in December.

the first really new pickup in a decade



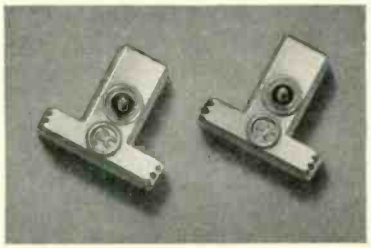
THE *fluxvalve* PICKUP

Made by perfectionists—for perfectionists. The FLUXVALVE is literally the cartridge of the future, its unique design meets the demands of all presently envisioned recording developments, including those utilizing less than 1 mil styli.

There is absolutely nothing like it! The FLUXVALVE Turnover Pickup provides the first flat frequency response beyond 20kc! Flat response assures undistorted high frequency reproduction – and new records retain their top "sheen" indefinitely, exhibiting no increase in noise . . . Even a perfect stylus can't prevent a pickup with poor frequency characteristics from permanently damaging your "wide range" recordings.

With this revolutionary new pickup, tracking distortion, record and stylus wear are reduced to new low levels.

The FLUXVALVE will last a lifetime! It is hermetically sealed, virtually impervious to humidity, shock and wear...with no internal moving parts.



The FLUXVALVE has easily replaceable styli. The styli for standard and microgroove record playing can be inserted or removed by hand, without the use of tools.

For a new listening experience, ask your dealer to demonstrate the new FLUXVALVE...words cannot describe the difference...but you will hear it!

"FOR THOSE WHO CAN HEAR THE DIFFERENCE"

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PIONEERS IN HIGH FIDELITY

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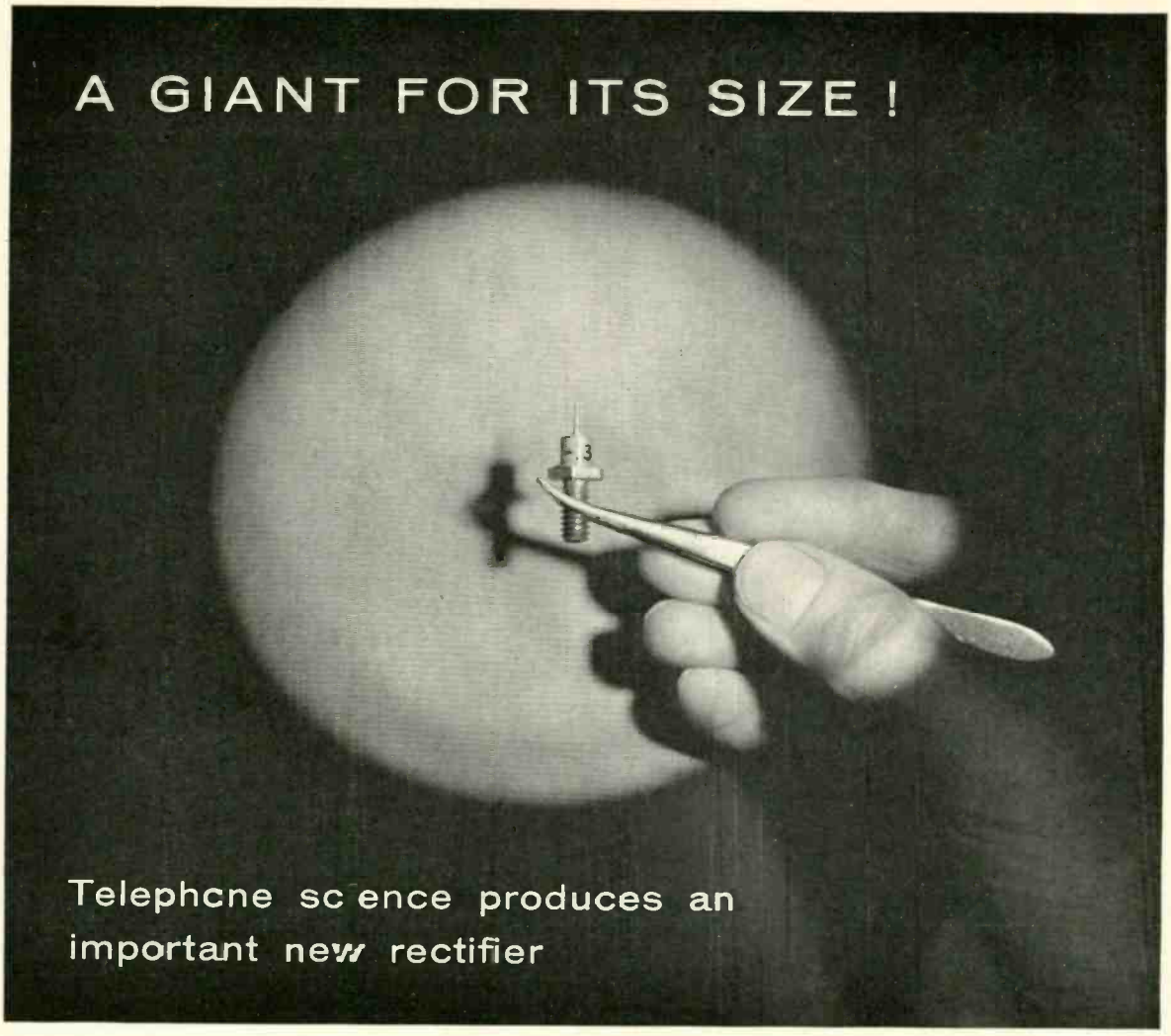
A GIANT FOR ITS SIZE !



Telephone science produces an important new rectifier

At Bell Laboratories one line of research is often fruitful in many fields. Latest example is the silicon power rectifier shown above.

Product of original work with semiconductors—which earlier created the transistor and the Bell Solar Battery—the new rectifier greatly reduces the size of equipment needed to produce large direct currents. It is much smaller than a tube rectifier of equal performance and it does not require the bulky cooling equipment of other metallic rectifiers.

In the Bell System the new rectifier will supply direct current more economically for telephone calls. It can also be adapted to important uses in television, computers, industrial machines, and military equipment. Thus, Bell Telephone Laboratories research continues to improve telephony—while it helps other fields vital to the nation.

Above, new rectifier (held in pliers) is contrasted with comparable tube rectifier and its filament transformer, rear. Mounted on a cooling plate, lower center, the new rectifier can easily supply 10 amperes of direct current at 100 volts, that is 1000 watts—enough to power 350 telephones.

BELL TELEPHONE LABORATORIES

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS

The "CW Horn"

A Constant-Width Folded Exponential Loudspeaker Horn

A loudspeaker enclosure of modest size which achieves the degree of realism necessary for high-quality sound reproduction. The secret?—a folded exponential back-loading horn which gives smoothness and an extended low-frequency range to its complement of one or two 8-inch speakers.

D. P. CARLTON*

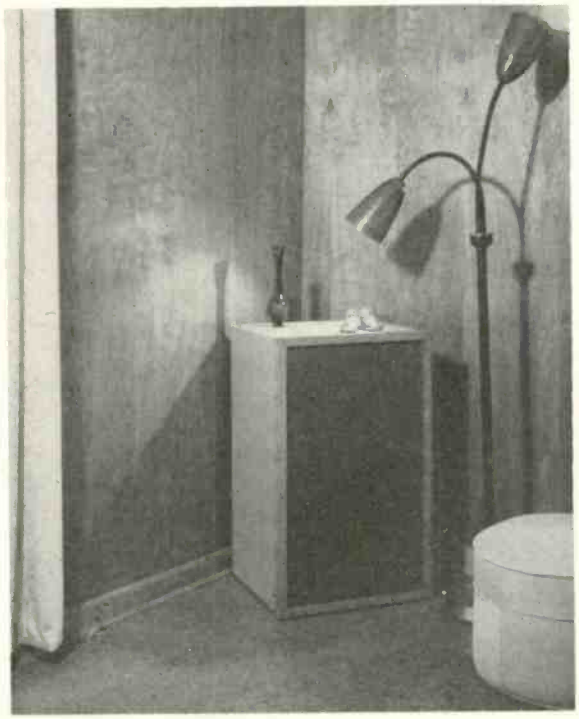
THE CONSTANT-WIDTH FOLDED EXPONENTIAL HORN which is described herein has been developed in a series of intermittent experiments which have continued since early 1942. My interest was aroused in 1939 by Combs[1] article on a homemade exponential horn. It was built to back-load an 8-inch speaker. I assisted in the construction of several Combs horns and my colleagues and I were impressed by the unusually fine, low-frequency response, the over-all clarity and crispness of the tone, the unusual sensation of presence, and the high efficiency of the cone and back-loading horn combination. The goal of my experiments has been to develop a smaller enclosure with a less complicated horn maze which would retain and perhaps surpass the fine qualities of the "Combs Horn." The result is shown in *Fig.* 1.

Out of the experiments has come a folded exponential horn designed with a constant width between its two parallel sides. It has a rectangular cross-section the height of which varies exponentially, along its length, from the throat to the mouth. This type of horn has been given the name "CW Horn". In such a horn, once the length and rate of flare have been chosen, the width may be changed from horn to horn without altering the exponential features.

The basic unfolded form of the "CW Horn" is shown in *Fig.* 2. The values for L, W, h_t and h_m are found in the next paragraph. The horn must be folded for two very practical reasons. The most obvious reason is to fit the horn into a box of convenient size and shape. The second reason is equally important. The horn itself transmits only the lower range of frequencies. However, by properly folding the horn the driving speaker may be used as a direct radiator for the important middle range of frequencies.

* *Box 2180, Houston 1, Texas.*

[1] E. E. Combs, Jr., QST December 1939.



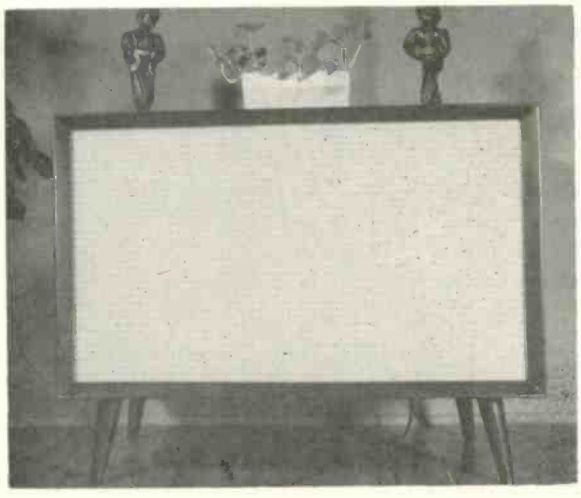


Fig. 1. Vertical mounting of small unit described makes a suitable high-quality speaker for the smaller room, as shown at left. For different decor, the horizontal mounting, right, may be preferred.

Figure 3 shows the folded exponential horn incorporated in this enclosure has a length, L, of 6 feet and a constant width, W, of 17 inches. The cross-section is rectangular. The height of the cross-section varies exponentially from 1¾ in., h_t, at the throat to 10 in. h_m, at the mouth. The corresponding cross-section areas are 30 and 170 square inches. According to McLachlan[2] a horn of these dimensions would have a low-frequency cut-off of 25 cps. This horn was deliberately designed so as not to limit the low-frequency of any 8-in. speaker that might be used with it.

In the present version of the CW Horn, a length L was selected so that when acting as an open organ pipe it would have a fundamental frequency f_r of about 90 cps to avoid any horn resonance near the principal hum frequencies of 60 and 120 cps. Using the formula, $f_r = 1100/2L$, (where f_r is 90 cps and 1100 feet per second is the velocity of sound in air), the calculated value of L is 6 feet.

The arrangement of the partitions, *Fig.* 3 shows the driving chamber to

[2] McLachlan: *"Loud Speakers,"* p. 183. Oxford Press.

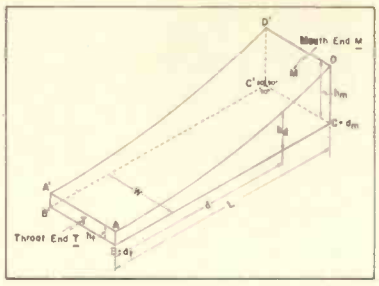
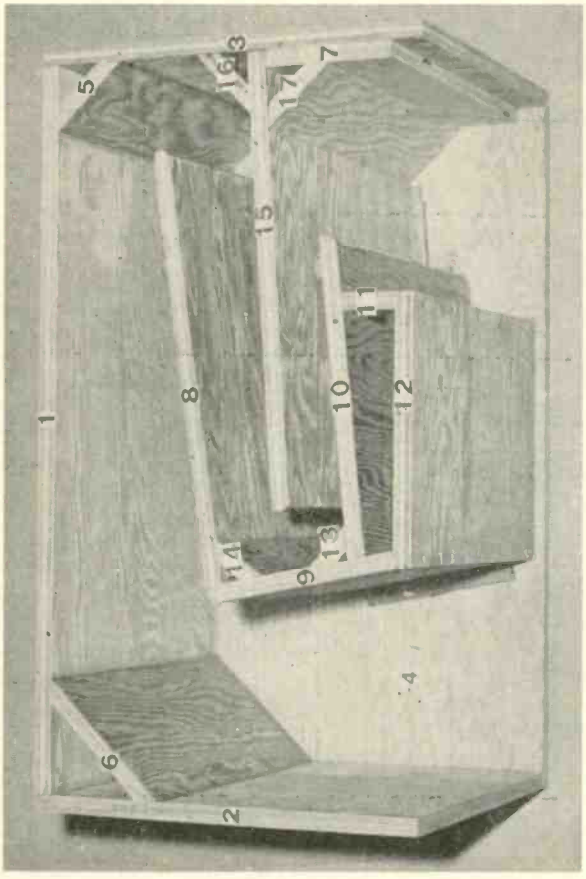


Fig. 2. Development of the exponential horn follows recognized principles.

which the speakers are to be attached as the folded exponential horn. Although the external dimensions are modest, the enclosure gives exceptional performance when used in high-quality home music systems. It should be noted that the present configuration of the parts makes use of almost the total cubic content of the cabinet and produces an inherently rigid structure. The material required to build the box can be cut from a single 4 × 8 ft. sheet of plywood with less than 5 per cent waste, and the use of a constant width for the folded horn results in remarkable ease of assembly.

Excellent performance may be obtained from the enclosure with one 8-inch cone speaker, preferably one with a rather low natural resonance and a cone surround sufficiently flexible to permit wide excursions of the cone at low frequencies. The low-frequency response will be well down into the lower 40-cycle per second range and it will be real, not the result of doubling. The use of a pair of 8-inch cones will produce a better over-all performance than a single cone, especially in the low-frequency spectrum. When desired, the high-frequency range may be increased by the use of a tweeter.

There are those who ask the question: "Why not use a 10, 12 or 15 inch speaker to drive the horn instead of 8-inch speakers?" The ease for the 8-inch cone arises from the fact that because of its shorter radius it will be stiffer and stronger than the larger cones. In operation, it will begin to function as a piston at a higher frequency than the speaker with the larger cones. There also will be less tendency for the smaller cone to buckle or otherwise lose its shape in driving the horn. The smaller, stiffer cone is better adapted to handling the



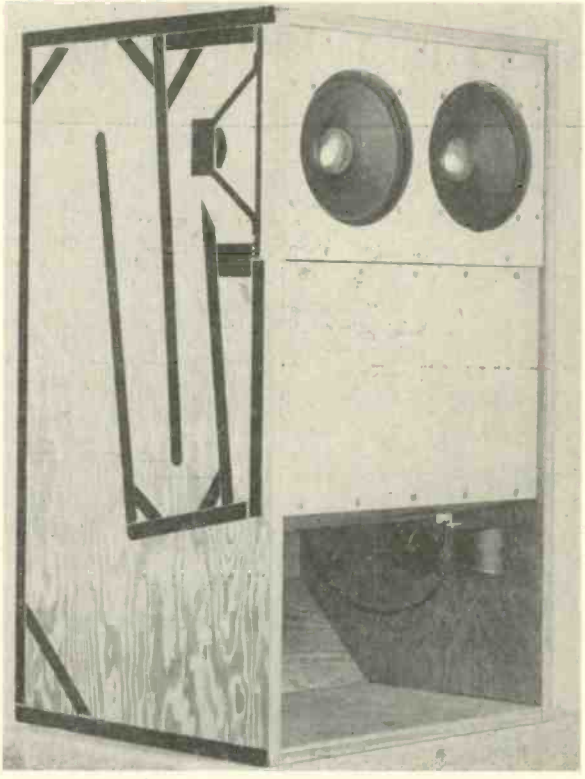


Fig. 3 (left). Internal construction of the folded CW Horn before mounting the second side. Fig. 4 (above). Finished CW Horn with two 8-inch Jim Lansing speakers and a University tweeter. Black tape on side indicates internal construction.

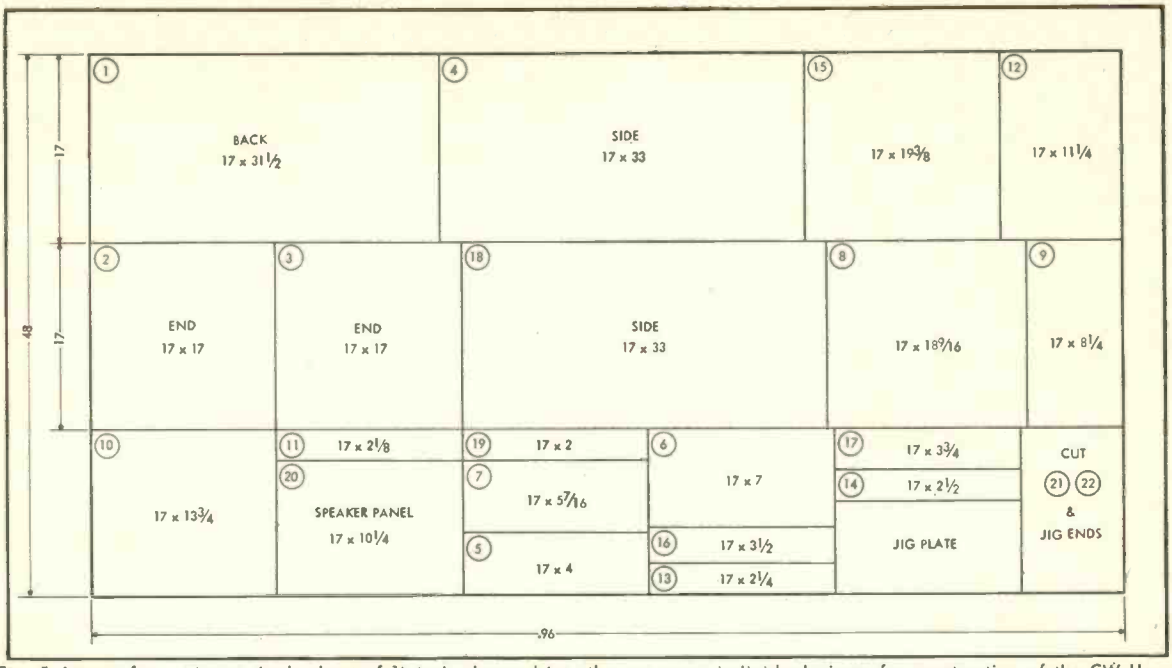


Fig. 5. Layout for cutting a single sheet of ¾ inch plywood into the necessary individual pieces for construction of the CW Horn.

high pressures developed by the long cone-travel required to produce low-frequency sound. The 8-inch cone will also give a superior mid-range response and eliminate the need for a mid-range speaker.

Selection of Speaker

In choosing 8-inch cones, there are many excellent hi-fi units upon the market. Permoflux, Stromberg-Carlson, University, Electro-Voice, Phillips, Jensen, Altec, Lorenz, Stephens, Jim Lansing, and the new PanaSonic are among the more prominent manufacturers. For tweeters you may turn to University, Electro-Voice, Stephens, Jensen, or Lorenz.

Figure 4 shows a CW Horn with a mounted complement of speakers. Upon the side of the enclosure a projection of the horn maze, speaker cavity and speaker has been shown to convey a better understanding of the utilization of the space within the box. Where two cone speakers are used it is necessary to mount the tweeter in the mouth of the horn. When using a single cone speaker and a tweeter both may be mounted on the panel. The orientation of the tweeter is dictated by the choice of the builder as to whether the horn is to be operated in a horizontal or vertical position.

Over the long period of development of the "CW Horn" numerous models have been built. A conscious effort was made to keep the over-all dimensions modest, always reasonably close to those of the described enclosure which, when made of ¾ in. plywood, has external

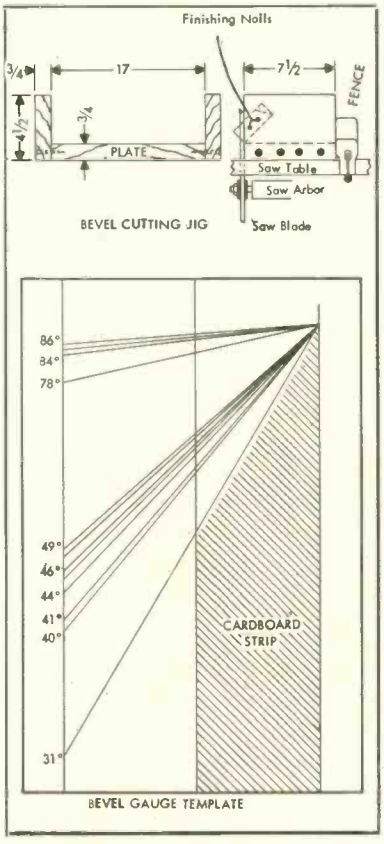


Fig. 6. (A) Layout of the jig designed to facilitate cutting the various bevels. (B) Bevel-gauge template for the angles used.

dimensions of 33 in. high, 18½ in. wide and 17 in. deep. Many varieties of 8-inch cone speakers and a few 10-inch cone speakers have been tried. Different varieties of material in various thicknesses, different lengths of horn, rate of flare, sizes of throat and mouth have been tried. The speaker enclosure which combines the most acceptable size, economy of structural materials and reasonable cost of electronic components with the best over-all performance is the one herein described. Some 50 to 60 of these horns are now being used by local hifi enthusiasts. Make one, equip it properly, and listen! You will marvel at the performance of this enclosure which certainly belies its size and cost.

Construction

The construction of the "CW Horn" is an excellent project for the amateur builder, especially if he has access to a power table saw and a power jointer. The plywood sheet should be cut into the 22 rectangular parts required as shown in *Fig.* 5. The cutting of the bevels where indicated becomes a simple job. Those who have no power equipment may be able to persuade the manager of the neighborhood planing mill to cut up the plywood sheet and make the bevels. The box can be made with hand tools. In this case, use fillets of soft, straight grained lumber, which is easy to bevel with a hand plane. A medium-coarse, flat bastard file, 10 or 12 inches long, is a good tool for making bevels on plywood where a relatively small amount of material is to be removed.

The photographs and construction de-

tails should furnish sufficient data to enable anyone possessed of a reasonable degree of skill to make the "CW Horn" with little or no difficulty. One skilled amateur, equipped with proper tools, built an enclosure in 4 hours; most builders will require 8 or more hours.

Perhaps each builder will see different ways to make the box; however, there are pitfalls that may lead to wasted material and unnecessary expense; therefore, for the first enclosure it is advisable to follow the orderly plan which experience has shown to be good, and which will be found in the paragraphs that follow.

Procedure

Before the required materials are purchased, a choice should be made as to whether to build with screws or 8d finishing nails; there is actually little or no preference.

Cut the plywood sheet (A-D exterior grade is preferable) exactly as directed in the cutting layout, *Fig.* 5 and number each piece properly as it is cut. There will be 22 rectangular pieces, 20 of which have the constant-width dimension of 17 inches. The two exceptions are parts 21 and 22 which eventually become part of the speaker panel seat.

A number of the pieces must be beveled with one or more of the angles indicated at (A) in *Fig.* 6. A simple template which may be used to mark the pieces or set a machine can be provided by using a strip of cardboard 6 to 8 in. long and ¾ in. wide, one end of which can be marked by use of the bevel gauge template, *Fig.* 8, and then the cardboard cut off at the required angle.

The bevel cutting jig of *Fig.* 6 is pictured in *Fig.* 7. It is a proven device for cutting the bevels accurately and *safely* with a power saw. It is especially useful with the bevels varying from 31 to 49 deg. Those bevels which vary from

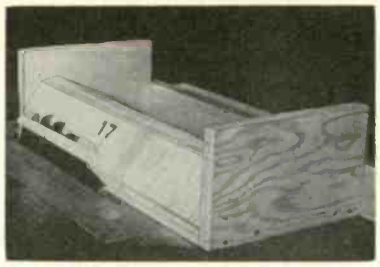


Fig. 7. Photograph of the jig shown in Fig. 6.

78 to 86 deg. can be readily and safely cut on the power jointer.

Having completed the preliminary details of cutting up the plywood sheet, making the beveling jig, and cutting the bevels, preparation for the construction of the box begins with parts 4 and 18 which are hereinafter called the top and bottom "sides," respectively. During construction the horn mouth is usually kept to the left, and the horn is built with the right side down—hence the terms top and bottom "sides."

Lay the bottom side (4) on the bench, smooth surface down. Draw on its upper "rough" surface the data shown in *Fig.* 8 with the exception of the fillets 5, 6, 13, 14, 16, and 17. Locate accurately points A, B, C, D, E, F and G. Draw the lines AB, CD, EF and AG. These lines control the positions of parts 8 through 14 and 15 through 17. Spot the position of the holes to be drilled for the screws or nails which are to hold the box together.

Builders may find it desirable to make a complete full scale drawing of *Fig.* 8 on tracing paper or brown wrapping paper and by means of carbon paper use it to transfer pertinent data to the top of part 4.

Lay part 18 on the bench, smooth surface up, and place part 4 on top of it with the smooth surface down. Clamp these two pieces together and drill the screw or nail holes, marked on part 4, through both pieces simultaneously.

An airtight horn is essential. Therefore, use glue generously and plenty of nails or screws. A small can of Reardon's or Walton's water putty will be found very useful for filling in voids which are often found in plywood. These materials do not shrink upon drying and both are excellent putties.

Assembly

Experience has shown that the actual assembly of parts may be divided into several well-defined phases which are as follows:

Phase 1: Fasten parts 1, 2 and 3 together with plenty of glue and nails and in turn fasten part 4 to their lower edges. Check with a square for rectangularity and then fix parts 5, 6 and 7 in place as in *Fig.* 9. The front edge of part 7 will eventually be part of the speaker panel seat while the back edge will control the position of the right end of part 15.

Phase 2: This involves parts 12, 11, 9, 10, 13, 8, and 14 (*Fig.* 9), which are assembled in that order. The use of temporary cleats M, N, R, S, T, and U bradded directly to the upper surface of part 4, will be a great help in keeping these pieces in their proper positions. Alternatively, this group of parts may be assembled on a bench or another piece of plywood in a duplicate set of cleats and the assembled parts set into place as a whole on the upper face of part 4 after Phase 3 is completed, *Fig.* 3.

Phase 3: This involves assembly of parts 15, 16, and 17 in place. Temporary cleats O and P, *Fig.* 9, are used to keep the left end of part 15 in its proper position.

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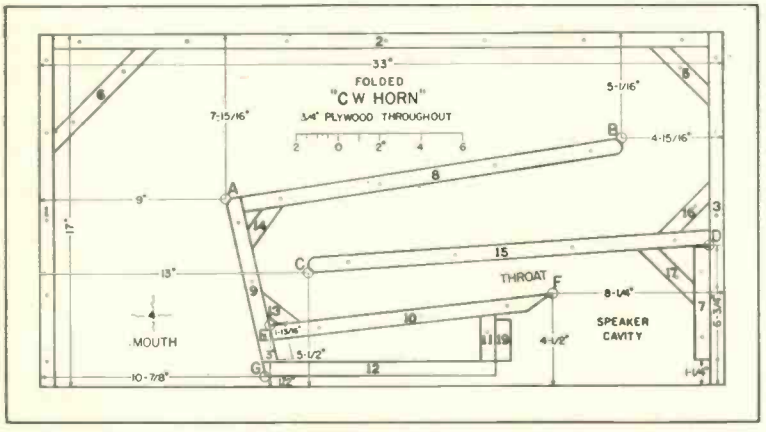

Fig. 8. Assembly of the horn, with pieces numbered in accordance with Fig. 5. Layout dimensions are shown.

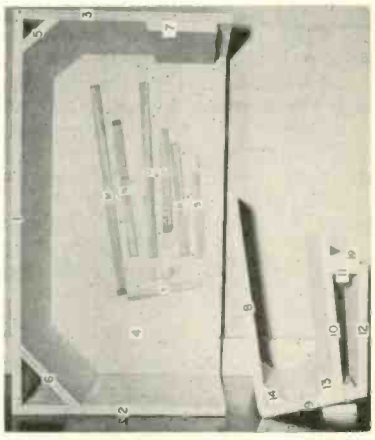

Fig. 9. Method of simplifying the assembly by use of temporary locating strips.

Effect of the Cathode Capacitor on P-P Output Stage

ROBERT M. MITCHELL*

Because of the fact that some amplifiers use a bypass capacitor across the cathode resistor in the push-pull output stage and some do not, the conclusions reached in this paper should be of considerable interest. Note, however, that these conclusions refer only to Class A amplifiers, while most modern amplifiers are designed to work up into the Class AB region.

WITH THE CONTINUED INTEREST in audio circuitry and design, it has become worthwhile for the audio engineer to re-examine some of the procedures that formerly were taken largely for granted. Among these procedures is the use of the by-pass capacitor in a Class A push-pull output stage. The purpose of this capacitor seems evident enough, yet the engineer is constantly finding circuits without this component and just as frequently finding circuits with it. To make the matter more puzzling still, he will read one author's admonition that its use is absolutely necessary, and another's that its use is specifically to be avoided.

In view of this ambiguity of opinion, it was felt that a test of the differences would be interesting. The results, which are not always as anticipated, are presented in this article, along with some evaluation of the outcome. The nature of this investigation necessitated the examination of some of the effects of balancing techniques in the output stage as well, and the results of this phase of the undertaking are also presented here.[1]

The Problem

Proponents of bypassed cathode operation maintain, among other things, that since the even-order harmonic terms which are generated in the output stage of necessity pass through the common cathode resistor, they therefore appear between grid and cathode of both tubes, are thus introduced as signal, and appear in the output. While it is quite true that these even harmonic terms do appear as a voltage drop from each grid to the common cathode, it is also true that since they appear as in-phase inputs at each grid, they are cancelled in the push-pull stage.

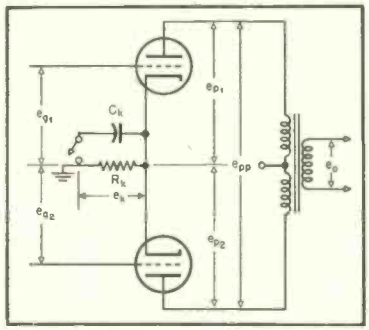

Fig. 1. Basic push-pull output stage arranged to switch capacitor in or out of circuit for measurements described.

Another and more serious charge is that the even-order distortion terms of all kinds which pass through the cathode resistor may cross modulate with the input voltage and thus introduce additional intermodulation distortion terms which, not necessarily being in phase with each other, may appear in the output.

As a representative of the other ("unbypassed") school of thought, Williamson states: (*Wireless World,* May 1947) "A feature of this arrangement is that the valves operate with a common unbypassed cathode bias resistor, which assists in preserving the balance of the stage under dynamic conditions," and in the August 1949 issue: "Due to the use of common unbypassed resistors for the push-pull stages, the amplifier is largely self-balancing to signal. . . ."

Here, then, are the two opposing views on the subject, and the reasons advanced for each by their respective proponents. Although the reasons advanced seem to be different, it is reasonable to assume that reduction of distortion is also the effect desired by Williamson, since this is one of the results of a balanced stage.

The Initial Approach

Figure 1 shows the basic push-pull output circuit with signal voltages labeled and the bypass capacitor in question, C_K, shown in series with a switch which will allow it to be inserted or removed at will during the course of measurements. It should be noted that this is the common type of push pull circuit, and the entire discussion which follows is confined to this circuit and does not necessarily apply to the "single-ended" or "series d.c." type of push-pull circuit.

The actual amplifiers used in the test were the UTC W-10 Williamson amplifiers, since these conform almost exactly to Williamson's circuit. (See *Fig.* 2.)

First Tests

The first measurements made were of total harmonic distortion, using a General Radio Type 1932-A Noise and Distortion Meter, and a low-distortion oscillator. The input frequency was 50 cps and measurements were made at power levels from 4 watts up to overload. These initial tests were made on an amplifier using 5881's in the output stage, and gave very consistent results. The addition of the bypass capacitor always increased the distortion, regardless of power level. The increase was very slight, but nevertheless very definite. The total distortion was small, so it became very difficult to measure, especially since the distortion of the oscillator itself was of the same order of magnitude as that of the amplifier. Consequently, it was decided to measure the performance without feedback. This change would increase the distortion, of course, but would not affect the action of the capacitor. The results of this test were similar, with distortion increasing when the capacitor was used. (See *Fig.* 3). These results were obtained consistently after numerous checks and rechecks, in-

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[1] The measurements described here were made at the laboratories of the United Transformer Company during the period when the author was director of those laboratories.

cluding tests at higher frequencies (500 and 2000 cps). Several curves were drawn and the data was about to be assembled for write-up when it was decided to substitute some other type of output tubes and see if there was any difference. Accordingly, a pair of 1614's was substituted and the tests re-run. The results were as complete a reversal of the trend as could be imagined! Almost every test showed lower distortion with the capacitor *in* the circuit. A typical measurement is illustrated in *Fig.* 4. In view of such conflicting results, it was decided to remeasure with as many different tube types and amplifiers as possible. Consequently, the test schedule outlined below was evolved.

(1) Four different stock amplifiers with 1614 tubes were checked for total harmonic distortion on a distortion meter.

(2) The same four were checked for individual harmonic distortion components on a wave analyzer.

(3) The measurements of (2) were made with different degrees of current unbalance.

(4) One amplifier was checked with four different sets of output tubes, all of which are directly interchangeable in the UTC W-10. These four sets included two pairs of 1614's and one each of KT66's and 5881's.

(5) The amplifier of (4) was checked for intermodulation distortion with the three tube types mentioned above.

(6) The amplifier of (4) was examined for transient distortion by the square wave method, with differing degrees of current unbalance.

(7) All measurements were made with the 100-μf bypass capacitor switched in and out of the circuit and the comparisons made point-by-point on an A-B basis. Care was taken to prevent any transient disturbance during connection or disconnection of the capacitor from being included in recorded data.

Results

The outcome of the harmonic distortion measurements of (1) was very inconclusive at low frequencies. The addition of the capacitor either reduced or increased the distortion depending on which type of tube was used, and even varied among tubes of the same type. At the higher frequencies, however, the addition of the capacitor quite consistently increased the distortion.

This ambiguity of results pointed up the need for a more refined analysis, so the next step was to measure the individual harmonic components on a wave analyzer. A fundamental frequency of 50 cps was chosen, and the second and third harmonics were checked, with output tube currents adjusted to produce these four different conditions:

(1) Minimum unbalanced current
(2) Minimum 3rd harmonic in the output
(3) Maximum unbalanced current in one direction
(4) Maximum unbalanced current in opposite direction

Again the results were indefinite, with different tube types or different tubes of the same type giving different results, and no preponderance of results one way or the other. *Figure* 5 shows a graphic comparison of the results of this test for two particular pairs of output tubes.

An interesting, and rather unexpected, finding was that the capacitor made a greater relative change in distortion, the closer the system was to balance, with the greatest differences in the two conditions taking place when the currents were adjusted to produce a minimum of third harmonic. This is shown clearly in *Fig.* 5. The condition for minimum third harmonic was also found to occur very close to that for minimum second harmonic, so close in fact that the two were practically coincident.

For example, when the currents were adjusted for minimum unbalance or minimum third harmonic, addition of the capacitor produced changes of the order of two or four to one. When the currents were greatly out of balance, however, the addition of the capacitor caused changes of the order of only 10 per cent or less, although the distortion terms were much larger, of course. It was also found that the condition for minimum unbalanced current was generally *not* the condition for minimum harmonic distortion. This is not surprising, since the fact that the two tubes are in static balance (d.c. conditions) does not mean that they are also balanced dynamically (a.c. conditions). The purpose of the balancing arrangement in the "Williamson" amplifier is primarily to minimize the unbalanced d.c. current in the output transformer primary, and thereby increase the low-frequency response, while simultaneously reducing core saturation.

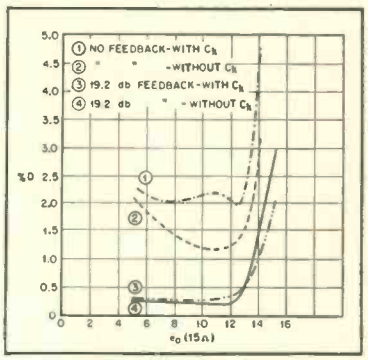

Fig. 3. Harmonic distortion curves on amplifier of Fig. 2. with and without bypass capacitor.

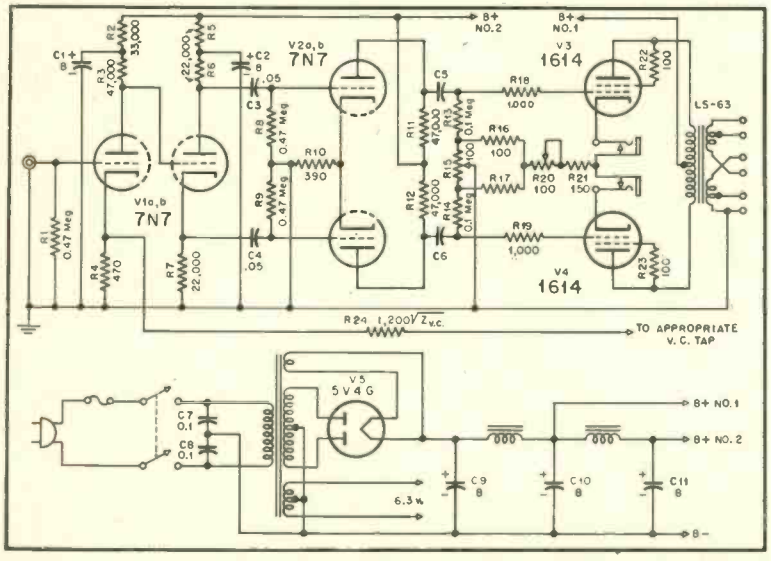

Fig. 2. Complete schematic of first amplifier used in these measurements.

Intermodulation Distortion

The next step was to measure the intermodulation distortion of the amplifier, and since the method of measurement was not that most widely used, a brief discussion of the technique will be of interest.

Intermodulation distortion occurs when two or more frequencies interact so as to produce frequency components which are proportional to the product of the input frequencies. One result of such a relationship is the production of frequencies

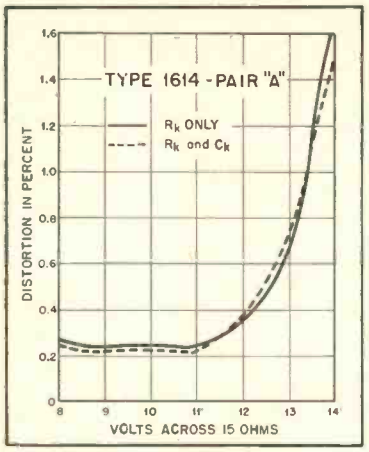

Fig. 4. Same measurements as Fig. 3 with different pair of tubes in the amplifier. These curves are plotted a different scale.

equal to the sum and difference of the two input frequencies, or of one input and harmonics of the other, etc. This action is the basis of our common system of amplitude modulation, where the production of such sidebands is a necessary feature of the process. In the commonly used (and most familiar) method of intermodulation tests, a high-frequency tone (the carrier) is modulated by a low-frequency tone, and the resulting sidebands detected and measured by a suitable circuit.

Although this method is an excellent indication of nonlinearity which generally correlates closely with listening tests, it was found that another method gave results which sometimes seemed to correlate even more closely. This second method of intermodulation distortion measurement also utilizes the fact that difference frequencies are produced. In this method, generally called the CCIF method, two high-frequency tones of equal amplitude and separated in frequency by a fixed amount are applied to the device under test. The output is measured by a wave analyzer tuned to one of the distortion frequencies such as $f_2 - f_1$, $2f_2 - f_1$, or $2f_1 - f_2$, and the distortion voltage is expressed as a percentage of the sum of the two input voltages. *Figure* 6 shows the two types of intermodulation in graphic form. One noticeable feature of the CCIF type is the location of the difference-frequency component $f_1 - f_2$. Since this component is so far removed from the two input frequencies, there is less tendency for the signal to mask the distortion as there might be in the SMPTE method, or in the CCIF method for the $2f_1 - f_2$ and $2f_2 - f_1$ terms. This difference tone is particularly objectionable when it falls in the region of maximum sensitivity of the ear (400 to 5000 cps), and is noticeable in amounts as small as a fraction of one per cent. It must be pointed out, however, that due to the difference in method of expressing percentages in the two methods, equivalent percentages are *not* indicative of equivalent degrees of nonlinearity. The SMPTE values appear relatively high while the CCIF values appear relatively low for the same nonlinearity.[2]

In using the CCIF method of measurement two procedures are commonly used. One is to select two fixed input frequencies and measure the distortion as the power output is varied. The other is to select a fixed power output level and to vary the two input frequencies simultaneously, maintaining a constant difference frequency. The first is rather readily accomplished, whereas the second requires either a special oscillator such as the General Radio 1303-A, or two oscillators calibrated with sufficient accuracy to enable the difference to be readily distinquished from the dial settings. The stock oscillator in the UTC laboratories is a decade-type oscillator with an accuracy of four places, and consequently is ideally suited to any such application.

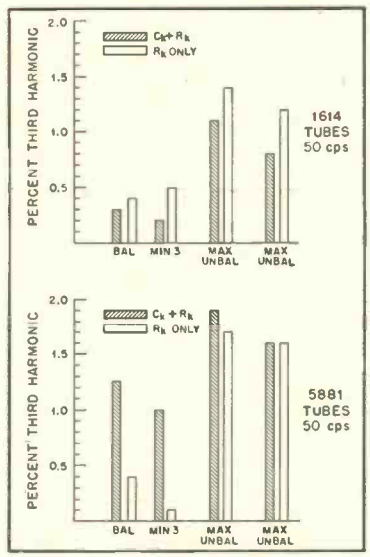

Fig. 5. Comparative distortions with different types of tubes in the output stage show different results.

Two such oscillators are used with the simple mixer-potentiometer circuit shown in *Fig.* 7 to provide control of frequency and output of either oscillator and the over-all voltage output. The isolating resistor networks prevent any interaction, and consequent intermodulation, between the two oscillators.

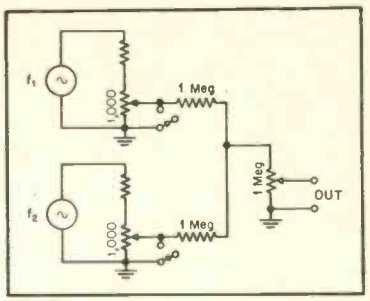

Fig. 7. Method of connecting two audio oscillators to provide CCIF type of IM signal without introducing intermodulation in the mixing circuit.

The CCIF intermodulation tests were performed using both methods mentioned above. When distortion was measured as a function of power level, the following relations were taken into consideration:

Since two frequencies are involved, a complex (nonsinusoidal) wave is produced, and the indication of an ordinary vacuum tube voltmeter is, therefore, not valid in determining the power level by the customary formula $P = E^2/R$. Furthermore, since one wave rides the other, the peak value of the two waves may reach a value equal to the algebraic sum of the individual waves, with the result that overload can occur for two frequencies when each is only one-half the amplitude required for overload by a single frequency. (See *Fig.* 8) Since each wave is only one-half the maximum amplitude, it can produce only one-quarter the power of a single maximum-amplitude wave. The power available from *two* such waves without any possibility of overload is, therefore, only one-half the power available from a single-frequency wave. The curves for the CCIF intermodulation tests are calibrated in terms of volts as read on an audio-frequency

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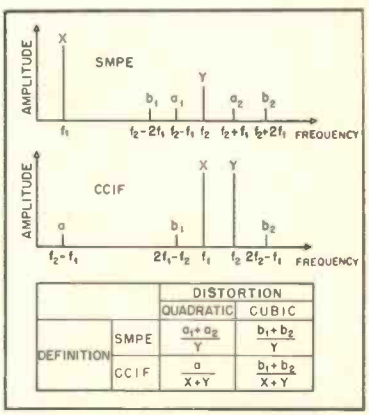

Fig. 6. Comparison of frequencies present in two different types of intermodulation measurements.

[2] A discussion of the two methods of intermodulation distortion measurement will be found in the General Radio Company Technical Publication B-3, *The Measurement of Non-linear Distortion*, by Arnold Peterson.

Design of Biflex Loudspeakers

A description of a new series of double-compliance cones just introduced to the hi-fi market and a discussion of the operating principles of loudspeakers of this type.

ALEXIS BADMAIEFF*

THE CONE-TYPE LOUDSPEAKER is one of the simplest forms of transducer for transforming electrical energy into acoustical radiation. The familiar single-cone speaker consists of a radiating paper cone driven by a voice coil attached at its apex and moving in the narrow gap of a magnetic circuit. Currents in the coil react with the magnetic field to produce the forces required to move the cone. Because of its simplicity of design and economy of construction, the single-cone speaker is used in virtually all inexpensive radios, television sets, cars, and industrial sound systems.

The frequency range of these speakers is quite limited when they are built at lowest cost. When the application will support the cost of additional refinement, the frequency range can be extended and a smoother response achieved. Despite the ingenuity of designers, however, compromises must be made between low-frequency and high-frequency reproduction when a single cone must be adapted to the full range.

To provide a response that equals or surpasses the hearing spectrum of the human ear, more complex speaker systems are required, usually comprising two units. In such systems, a speaker designed for low frequencies reproduces down to the deepest bass and a high-frequency speaker reproduces up to the highest audible tone. An electrical crossover network is usually used to divide the sound spectrum between the two speakers. Two-way loudspeaker systems are much more costly than the single-cone speaker and many music lovers find them beyond their reach.

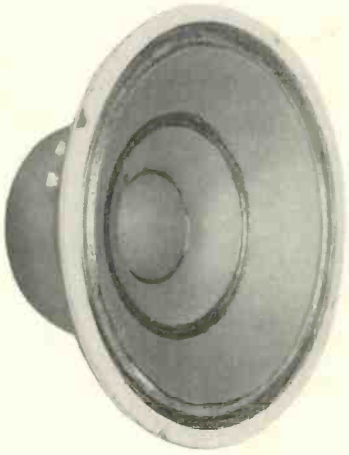

Fig. 1. The new Altec Model 412A Biflex loudspeaker.

Much effort has been expended to add substantially to the range of the single speaker and still retain its low cost attractiveness. If its frequency response can be made uniform from extreme bass to within half an octave of the hearing limit, it would approach the response of hi-fi loudspeaker systems of two or three times the cost. A relatively large cone is necessary for the radiation of reasonable amounts of power at low frequencies, but large mass limits effectiveness at high frequencies. A 6-inch cone, for example, equipped with an aluminum voice coil, can be designed to have excellent high frequency characteristics, but very little power can be radiated at low frequencies by such a small radiating area. If such a small cone could be combined with a cone of larger area so that the bass response would be improved, then the advantages of a small surface area, reproducing the high frequencies, and the advantages of a large surface for reproduction of good bass could be realized. Because of cost consideration, such a structure should be driven by one voice coil, and retain the simplicity of a single-cone construction.

One way to achieve the performance of the combined double-cone loudspeaker would be to have the smaller cone reproduce high frequencies and the combination of the two cones reproduce the middle and low frequencies. This can be accomplished by introducing a compliance in the middle section of a large single cone. The compliance permits the outer portion to become decoupled at high frequencies, in which region the inner area becomes free to vibrate without carrying the mass of the outer area.

Below a "crossover," the reactance of the compliance will become high in relation to the mass of the outer area, and the two areas tightly coupled will then act as a single cone. Construction of such a cone is shown in *Fig.* 2. The stiffness of the mid-compliance could be so chosen that it places the "crossover" at, for example, 1,000 cps. The compliance would consist of two concentric corrugations in the cone, as shown in *Fig.* 1, terminating the smaller inner area and acting as its edge compliance. Above 1,000 cps, the inner portion of the cone alone would be driven by the voice coil and radiate effectively while the larger outer area would be essentially motionless and act as a baffle for the smaller cone. A curved contour given to the outer area of the cone further improves the high-frequency response because of the avoidance of difficulties from close-by irregularities in the normal cabinet baffle surface. At frequencies below 1,000 cps, the two areas move in unison and constitute an effective low-frequency radiator.

It is probably fairly obvious that such

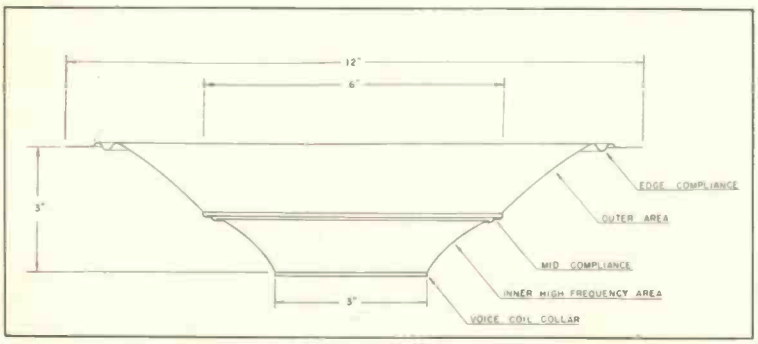

Fig. 2. Double-compliance concentric cone, with nominal dimensons.

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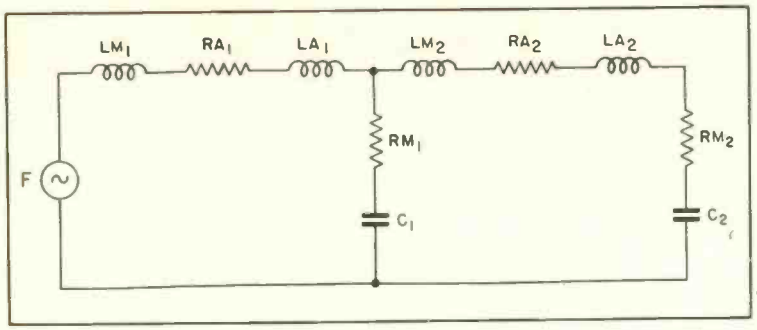

Fig. 3. Analogue of a loudspeaker with a double-compliance cone.

a system would perform well at low and high frequencies. The action in the region of "crossover" is more complex. It was recognized from analysis of the mechanical system that disturbances would occur in this region due to shift in the relative phase of the velocities of the two members. Tests of a cone containing the simple mid compliance fully confirmed this expectation.

Equivalent Circuit

The reason for the irregularities and the explanation of the operation and functions of the various component parts of the double-compliance cone can best he explained by the use of an equivalent electrical analogue. A simplified analogue of the double-compliance cone is shown in *Fig.* 3 and its mechanical schematic in *Fig.* 4. The analysis of the analogue is as follows. The mechanical generator F represents the force produced by the currents in the voice coil reacting with the magnetic flux in the air gap of the magnet assembly. The force produces a velocity in a network consisting of a lumped mass Lm_1 of the voice coil and inner area of the cone, the air mass La_1 acting on the two sides of the cone, the radiation resistance of the air Ra_1, the mid compliance C_1 and its small mechanical resistance Rm_1. Up to this point, this is a typical analogue of a single-cone loudspeaker if "edge compliance" is substituted for "mid compliance." This element in a conventional single cone would represent the compliance provided between the conical surface and the frame. However, there is now a second branch added in parallel with Rm_1 and C_1 consisting of mass Lm_2 representing the outer area of the cone, the added radiation resistance Ra_2, the radiation mass La_2, the edge compliance adjacent to the frame C_2 and its mechanical resistance Rm_2. The low-frequency branch is driven by the inner cone through the mid compliance C_1. As a rough approximation, we can assume that above the frequency of resonance of Lm_1, La_1 and C_1, the velocity in the second branch (Lm_2, La_2 and C_2) will be 180 deg. out of phase with the velocity in the first branch if the shunt contains capacitance only, but 90 deg. out of phase if the shunt is resistive only. This will be apparent when it is recognized that the second branch velocity is derived from the drop across the shunt branch divided by the impedance of the second branch, and that the latter impedance is dominated by mass reactance. In this analogue, the total output is proportional to the sum of the squares of the two velocities multiplied by their respective radiation impedances. Consequently, by increasing the resistance of the mid compliance, the phase difference in the two branches cannot substantially exceed 90 deg.

The increased mechanical resistance could be achieved by applying a layer of viscous damping liquid to both sides of the cone at the mid compliance. This preparation, when dried, becomes a viscous plastic layer which acts effectively as a resistance, and does not lose this property with the passage of time. To further reduce irregularities in the over-all response characteristic, the magnitude of the mechanical resistance in the edge compliance Rm_2 is raised to damp the low frequency branch of the network and to prevent reflections from the edge of the cone. The wave motion, as it travels from the center of the cone out to the rim, is substantially absorbed by the mechanical resistance of the damping layer and prevented from reflecting back. This action greatly reduces the standing waves in the cone which would appear as serious irregularities in the response of the cone. The edge-compliance portion of the cone is considerably thinner than the cone proper in order that the stiffness would be reduced to the point where it will resonate with the cone assembly mass at about 50 cps. The same viscous material could be used to accomplish this purpose.

Careful attention to the design of the voice coil and the inner portion of the cone was required to gain the maximum high-frequency extension of the over-all range and to secure a smooth characteristic in this region. An efficient light coil of edge-wound aluminum ribbon was adopted. Determination of the detailed contour of the cone was worked out experimentally through a series of measurements in an anechoic chamber.

(Continued on page 71)

TABLE I

Type	Nominal Dia.	Res. Freq. (max)	Watts	Voice Coil		Dia.	Depth	Mtg. Hole Diameter	Flux Density Gauss	Magnet Weight (lbs.)
				Imped. Ohms	I.D. Inches					
408A	8″	75	15	8	1.760	8⅛″	3½″	6⅞″	10,000	0.65
412A	12″	50	20	8	3.005	12⅛″	5⅜″	10¼″	11,400	1.8
415A	15″	45	25	8	3.005	15 3/16″	7″	13¼″	13,500	2.4

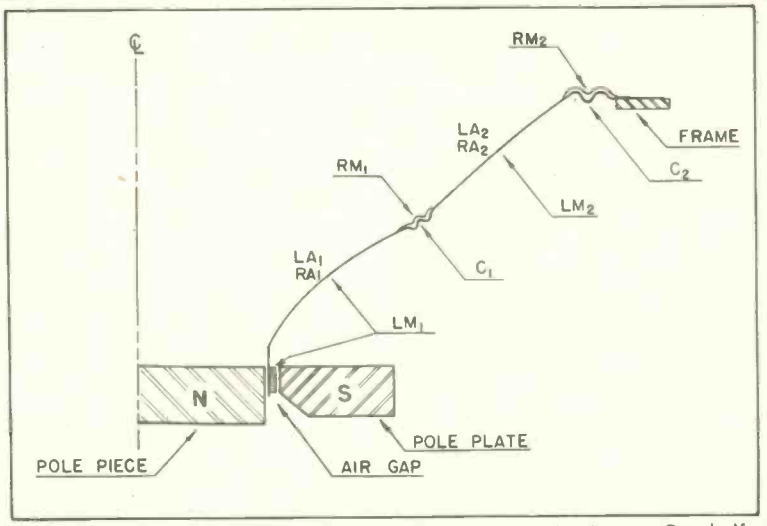

Fig. 4. Double-compliance cone with voice coil in a magnetic air gap. One half of assembly shown.

La Alta Fidelidad en Mexico*

OTTO MAYER-SERRA**

From the editor of a record magazine—which regularly carries a 24-page section devoted to hi-fi—come these comments about the increasing interest in audio among our neighbors to the South, where the people are being treated this month to their first Audio Fair

THE OPENING of the first Mexican Audio Fair this November 3rd at the elegant Hotel Reforma is expected to augment the interest of the general public in High Fidelity, which is just starting to fascinate our real music lovers and to become a fashionable hobby of the so-called upper classes. About 35 companies will participate in the Fair, and will exhibit some 85 different products, mostly American and some European, English predominating among the latter. The Fair is being organized by the AMIAF (Asociación Mexicana de Impulsores de Alta Fidelidad), an association of "promoters of Hi-Fi," which was formed about a year ago by a small group of distributors and representatives. Little by little, they have convinced the whole industry that it is a good thing to get together and stimulate interest in audio for the common benefit.

As elsewhere, the interest in Hi-Fi equipment started, of course, with the most sophisticated *connoisseurs* of classical recorded music. It is significant that up to now, the biggest record store, which for over 15 years has had the clientele of the exclusive and demanding group of professional people (lawyers, doctors, judges, bankers) who customarily patronize symphony concerts and other good music, has also been the biggest seller of audio equipment. Their annual sales of equipment are about $100.000, an amount approximately equal to their record sales. There is only one other store coming close to this figure; it was opened about a year ago, and for the first time offered a great number of different labels, exhibited in a variety of combinations in an attractive shop. The novelty of their installations made them very popular and successful, and their example will be followed in the near future by others, who will open big and flashy new audio shops. Up to now, the audio stores, with the one exception mentioned, handle exclusively one or a few products, and generally are representatives.

Exact figures about sales are difficult to obtain. The official statistics are not up to date, and the different companies jealously guard the secrets of their sales figures. However, from varying sources, we have gathered some data on record sales which give a very approximate idea of the scope of the audio business in Mexico. Possibly about 500,000 LP records are imported annually from the United States. To this must be added the national production of popular music on 78 and 10-in. LP records. There are four factories in production: RCA Victor Mexicana, Panamericana de Discos (who bring out the Musart label and press Capitol); Peerless, and Discos Columbia de México. Beginning next year, a Decca plant will start operating in Mexico, financed exclusively—as are Panamericana and Peerless—by Mexican capital. In Mexico City, there are about five stores which annually sell around $100,000 dollars worth of records. The other 275 agencies—as well as the 380 shops in the provinces—which sell LP, fall far behind this figure, but all together and combined with the record departments in several big department stores they absorb the total amount of imported and locally produced records. And this is not counting the 35,000 juke boxes all over Mexico, the largest consumers of the 78 and 45 records.

So far as figures are concerned, it is clear that the audio market of Mexico is not yet "big business" by American standards. But it is steadily growing and all the companies which represent equipments claim that during the last four years—that is, since they have started bringing in audio elements for home use—their sales have increased 100 per cent each year. The "big boom" is still ahead, but it will come within the next 2 years. It will take more time to develop here than in the states, because of certain conditions prevailing in Mexico.

Like all Latin countries, Mexico is predominantly agricultural, and is struggling hard to achieve the technological advancement standard in the highly-industrialized Anglo-Saxon countries. Although the Mexican technician is skillful and has a great deal of imagination, he is not self-confident enough to approach new problems in fields or with equipment he does not dominate. If he has a wide experience, with, let us say, the Rek-O-Kut turntable, which he has handled at most of the radio stations, he will touch a Collaro or a Thorens only reluctantly. The same thing is true of amplifiers and pick-ups. Further, cabinet

* High Fidelity in Mexico.

** *Editor, "33 1/3" Magazine, Apartado 8688, Mexico 1, DF.*

Maria Aguilar (standing), chairman of the Organizing Committee of the Fair, explains its purpose in a meeting of representatives and distributors of audio. Seated, left to right, are Adalfa Rodriguez, Manuel Angel Fernandez, and Merle B. Hayes—treasurer, president, and vice-president, respectively of AMIAF.

makers are still slow, and sometimes unreliable, in delivery of their products. This means, in a word, that service here is still deficient. More than one Hi-Fi fan becomes irritable or desperate when the technicians struggle for months to make his newly acquired audio equipment work properly. Electronic engineers are rare, and the few existing are connected with the big companies, like General Electric, Stromberg-Carlson, and Philips, or with the University or the Polytechnic High School, or with one of the television stations. On the other hand, very few of the owners of our hi-fi stores are themselves really specialists in audio, although they and their assistants are learning all the time, and probably this handicap will be overcome shortly.

Another condition affecting the audio industry is the fact that Mexicans, because of the character of their country, are not naturally technical minded. Although there exists a League of Short-wave fans, with a limited number of members, the general public is unable to solve even the smallest technical or mechanical problem. You will never find the man who attends concerts in the Palace of Fine Arts putting up nails to hang pictures, painting his kitchen, or repairing his car. "Do it Yourself" has not hit Mexico and would get a cold reception. The Mexican who buys Hi-Fi equipment will use it for a long time, and he lacks the mechanical curiosity of the American, who is constantly trying out new devices and working to improve his equipment. Nevertheless, a change is being observed. More and more people are intrigued and excited by new labels, and when their neighbors in the fashionable suburbs get better and more expensive equipment, they are likely to start looking around in their favorite shops until they make up their minds—or are talked into—improving their equipment.

The bright future of Hi-Fi in Mexico lies in the tremendous love of Mexicans for good music. Over six years ago, when the first LP's appeared, the owners of big 78 record libraries were indignant, and considered the microgroove record to be a trick of the big companies to devaluate their recorded treasures and oblige them to invest more money in the new disc. But they very quickly realized the enormous superiority in quality, and one year later the 78's were as dead an issue in Mexico as elsewhere.

The Mexican public is more interested in the music itself than in the sound qualities of the record. Although a high standard of sound reproduction is fully appreciated (the wide acceptance of Westminster's Laboratory Series proves this), the buying of records is chiefly because of interest in a specific work and its interpreters. Because of their political history and cultural background, the Mexican people are more impressed with European achievements than with those of the United States, in the field of art. It is common talk that the American is "materialistic," incapable of spiritual appreciation. Part of this roots in the deep religious feeling of the Mexican, who, though he lives in one, does not really accept a completely secular organization of life, which is the American ideal.

Sound room of one of Mexico's oldest and most fashionable record shops, owned by Don Gustavo Allegre.

The high-speed and the over-brilliance of Toscanini or Mitropoulos performances (so liked in the States), are here valued less than the profound spiritual and emotional impact of readings by conductors like Furtwängler, Jochum, Kubelik, Karajan, or Kletzki. This is the reason why labels like London, Angel, and Deutsche Grammophon (imported directly from Germany) are among the favorties of the real *connoisseur*. The wonderful roundness of tone of the latter two contribute to make them preferred. Something similar is true regarding audio equipments: the Garrard dominates the field of record changers completely, and the Leak and Quad are increasing steadily in amplifier popularity. The day German industry goes into high fidelity, it is sure to find a wide market in Mexico.

Because of high protective duties, record changers are assembled here through arrangements with some big radio or television assembling plant, or by the distributor himself. Probably within less than a year the same thing will happen with amplifiers. Two companies led by young Mexican electronic engineers have brought out and marketed their own amplifiers, with excellent acceptance. One very small FM station is already working many hours a day, and before the end of the year, another one planned on a larger scale will open and push the sales of a cheap FM receiver, as well.

One corner of Mexico's newest audio shop, owned by John M. Coleman.

Fletcher-Munson Again

A discussion of the possibility of introducing compression in the low frequencies to limit the loudness range in an effort to have signal-controlled loudness compensation.

NORMAN H. CROWHURST*

LOUDNESS LEVEL CONTOURS, first published by Fletcher and Munson in a technical paper titled "Loudness, Its Definition, Measurement and Calculation", in the *Journal of the Acoustical Society of America*, have been published in almost every technical magazine even remotely connected with audio. Some must have published the curves several times over. A tremendous lot has been said about these curves, and the deductions that may be made from them, and considerable argument has arisen, from time to time, on the correct interpretation and application of the curves to achieving realism in reproduction at different levels. The term "scale distortion" was invented to describe the change in quality apparent when a program is recorded at one level and reproduced at a different level with flat overall response.

To try and arrive at a correct summary of the various conclusions drawn would require wading through a great many articles and a considerable amount of "sorting the wheat from the chaff." The author does not intend to do that here; but quite recently, in a discussion about the effectiveness of a particular loudness control, the writer realized a basic fact, evident by deduction from these curves, that careful reading of all the literature heretofore published on the subject had not brought home to him. Maybe the fact *has* been clearly stated before, but, in view of the fact that the writer has not heretofore "seen the wood for trees," he thinks it probable that many other readers might find it beneficial to have this point clarified.

Probably the best way to explain matters would be to go over the discussion which led to this realization. A friend, who has comparatively recently become interested in high fidelity, was asking for an explanation of a fact he noticed with his own equalizing networks. Apparently his preamplifier—a home-built job—incorporates two separate controls: a loudness control, which is intended to vary the response to simulate the Fletcher-Munson curves; and also a separate bass boost and roll-off control.

The comment our friend made was that the loudness control does not appear to have any effect whatsoever when the bass boost and roll-off control was set at the level position. However, when he turned this control to the lift position he could hear quite pronounced difference as he turned the loudness control. Was the bass control interacting in some way with the loudness control?

An examination of the circuit—which is unimportant to this discussion—showed that any form of electrical interaction of this nature was extremely unlikely. However, examination of the Fletcher-Munson curves—especially in the light of previous experience—quickly shows the reason.

At 1000 cps and upwards, a change in intensity of 120 db corresponds with a change in loudness of 120 phons, but in the region of, say, 50 cps a change in intensity of 30 db represents a change in loudness of 70 phons, from threshold up. If the response in the flat position is reproducing at a level that is below threshold in the region of 50 cps, then adjustment of the loudness control might have no audible effect. On the other hand, by providing a low-frequency boost that brings the operation of the loudness control up into the 30 db range, which corresponds to 70 phons change in loudness, its audible effect becomes very pronounced.

Probably the reader has himself had experiences somewhat similar to this. He will have noticed that the operation of controls varying the response at the high end seems to be reasonably consistent, at whatever level the system is operated. Although the Fletcher-Munson curves have that curious wiggle from 1000 to 15,000 cps, they are all approximately uniformly spaced throughout this range. For this reason, whatever effect the wiggle has will be the same, regardless of level setting. However, operation of a low-frequency control sometimes seems to have more effect than at other times, according to the level at

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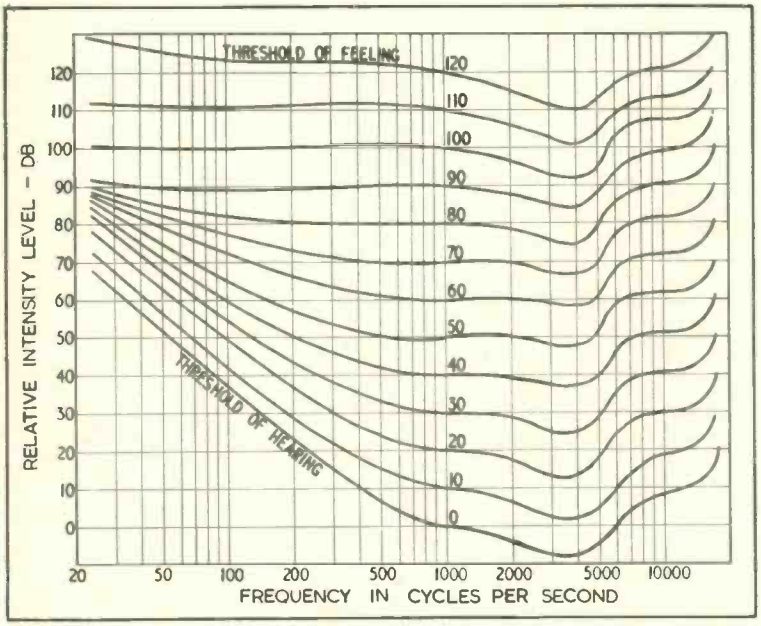

Fig. 1. The well-known loudness level contours, published by Fletcher and Munson in their paper, "Loudness, Its Definition, Measurement and Calculation," J. Acous. Soc. Am., Vol. V, No. 2.

which the system is operating, or according to the type of program material being reproduced.

Sometimes adjustment of the low-frequency boost and cut control seems to have practically no effect and at other times it appears to have a very marked effect. The reason evident from the foregoing explanation is to be found in the convergence of the loudness contours at the low-frequency end.

Restatement of F-M Curves

The matter may be made a little clearer from the graphical point of view, by redrawing the information presented in the Fletcher-Munson curves with the references inverted, that is, using intensity contours plotted against a scale of apparent loudness. This can be simplified and made more informative by referring to a normal intensity of, say, 60 phons, normalizing the whole thing, so that the intensity loudness relationship appears to be flat at this one level. This will then clear away the confusion caused by the actual shape of the curves which does not influence the effect on apparent response of the reproduction because they are almost equidistant at the different levels at the high end.

Figure 2 shows the curves redrawn in this manner. It will be seen that the lower curves, representing the lower intensity levels show low-frequency roll-off at a frequency high enough to be above the low-frequency resonances of many loudspeaker units. Operation of a system in this intensity region will cause frequencies below this roll-off to be entirely missing. And any minor adjustment in frequency response down at this end will not be audible because the frequencies themselves are not audible.

Some or all of this has probably been said before although the writer has not previously realized quite the significance, as brought to his attention by the foregoing discussion. The big question really comes—and this was the purpose in writing this article—*what are we going to do about it?*

The ultimate objective in all reproducing systems is to achieve an impression of realism. Some still contend that the only way to do this is to reproduce the original sound field carefully and accurately, and this means, among other things, reproducing everything in its proportionate original intensity. If this basic objective were possible, it would mean that we would reproduce precisely the same sound that we should have heard had we been sitting where the microphone was placed during the original performance.

Here is one difficulty. As has been pointed out many times previously, the acoustic properties of the original studio or auditorium and the acoustic properties of the room in which the program is reproduced, each affect the sound of the program material in a different way. In this particular connection, as some writers have previously pointed out, we are not sure that we will want to hear the program sounding exactly as it would if we were to sit where the microphones used for recording it were placed.

If the microphones are placed in a position representing a typical member of the audience, experience has shown that too much of the auditorium acoustics are included in the recording. It is better to select a position which discriminates more for the direct sound wave and against reflected sound waves due to auditorium acoustics. So right at the outset we hit against the impossibility of reproducing what we would hear naturally.

Concert Hall Volume?

There are other reasons why this objective is impossible, which have been fully discussed in all their diverse forms many times already. But it is still not universally recognized that this objective of recreating the original performance is not at all a practical basis. So let's get honest with ourselves and admit that the real objective can not be what we would hear naturally at the original performance, but what we think we ought to hear, or what we feel we would like to hear.

Even in original performances sometimes a sense of balance is not quite what the recorder feels is necessary, so he introduces equalization so that the recorded program material has the sense of balance that he feels is right for this particular program material. This then represents a deliberate attempt to improve the sound of the original performance.

From *Fig.* 2 it is evident that the human ear acts as a kind of expander for the low frequencies in the audio range, expanding a dynamic range of 30 db, or so, up to an apparent loudness range of 70 phons. Most modern program material aims at achieving a dynamic range from 50 db and upwards, and some program material even aims at a dynamic range of 70 db. But at the low frequencies a corresponding electrical dynamic range of 30 db will appear to represent a loudness range of 70 phons.

If there is a dynamic range in the recorded material at the low end of 30 db, which is right for expansion to apparent loudness change of 70 phons, then this will sound quite good—*if the 30 db available happens to coincide in level* with the position the intended 70 phons range of loudness contours occupy. If however, the 30 db dynamic range at these frequencies happens to fall below the threshold level on the loudness contours the whole of this dynamic range will fall into the inaudible region.

So some adjustment should be made to bring the 30 db of low-frequency dynamic range to the correct level to make

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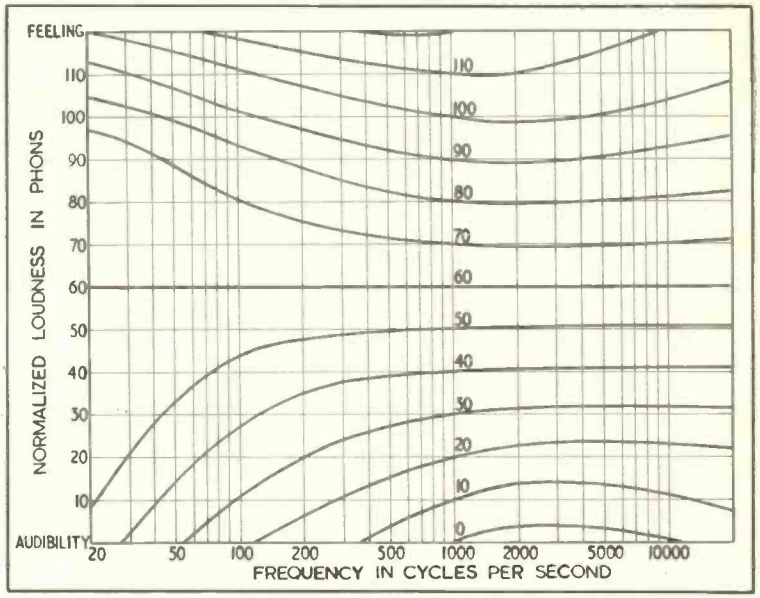

Fig. 2. The information presented in the loudness contours replotted in the form of intensity contours, and normalized corresponding to the loudness contour for 60 phons. Other loudness contours could be used as normalizing reference, with resulting change in shape of the whole family of curves—the line for normalizing reference level being flat in each case.

Technical Aspects of the "Briggs" Concert

P. J. WALKER*

Details of the equipment used in presenting a loudspeaker demonstration in Carnegie Hall—including the power indicators, amplifiers, and control facilities. The author also discusses parallel operation of amplifiers and loudspeakers.

WHEN GILBERT A. BRIGGS first announced his intention of taking London's Royal Festival Hall for a lecture/demonstration of Sound Reproduction there were many who doubted the wisdom of such a venture.

Apart from the doubt as to whether three thousand people would pay to come and listen to loudspeakers, many suggested that the loudspeakers themselves might well not show up favourably under such test conditions. In a Concert Hall where one is used to listening to orchestras in the flesh, even slight discrepancies from natural would immediately be apparent.

Rumour has it that commercial records were to be used. Such discs are recorded with "Concert Hall Colour" as they are intended for home use where they are required to produce a sound picture—a picture through which one should hear the Concert Hall with the orchestra in it. How would such records fare when reproduced in the Concert Hall itself? Surely to re-create the orchestra, special close microphone recording would be required.

Mr. G. A. Briggs, who conceived and executed the two concerts in Royal Festival Hall in London and the latest one in Carnegie Hall.

The only way to resolve such doubts was to go right ahead and try it. This Mr. Briggs—G. A. B.—had the courage to do, trusting that after all if an orchestra sounds well in the Royal Festival Hall then good loudspeakers should also sound well. That his decision was right was shown by the immediate demand for a repeat performance in the Festival Hall followed by innumerable requests to stage a similar event in New York, culminating in the Carnegie Hall Concert on October 9th.

There is a prevailing philosophy which judges quality of reproduction by its "high-fidelity" features. How low will it go? How much top is there? How much presence? and so on. This approach serves a purpose but is fraught with dangers since it is quite possible to emphasize such features to the extent that the reproduction becomes more "Hi-Fi" than the original orchestra!

High fidelity is not, of course, an end in itself and is only justified in its ability to assist and preserve the connection between the listener and the music. The Carnegie demonstrations were chosen with this approach in mind and the temptation to concentrate solely on the dramatic was resisted. The music therefore varied from some delicate Mozart to a full orchestra and choir in Vaughn Williams *Sea Symphony* with E. Power Briggs on the Carnegie organ added for good measure. One recording was "odd man out"—a George Elliot recording of a tugboat on the River Thames, put into the programme when the "hi-fi urge" became too great.

Power Requirements

Power output requirement for the home is a subject of ever-conflicting argument. Power output required for the Concert Hall however, is capable of more precise statement since the desired result is capable of accurate definition.

Allowing for 10–12 db loss due to loudspeaker efficiency, the literature shows that in order to produce the peak wattages produced by a full orchestra

* *Acoustical Manufacturing Co., Huntingdon, Hants, England*

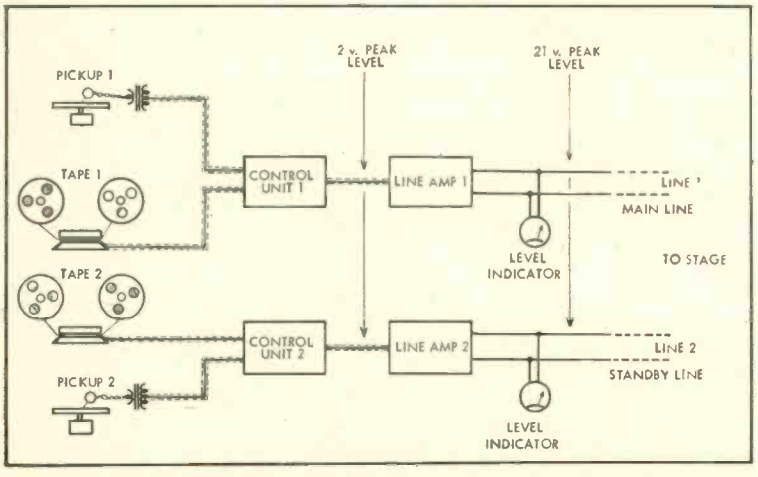

Fig. 1. Block schematic of the control position equipment which was located in a box in the auditorium.

an amplifier capable of several hundred watts would be required. Tests carried out by the B.B.C. and other authorities however, show that peaks of *very* short duration may be removed without loss of quality, and this is taken into account in the setting of modulation levels, either for recording or broadcasting. With such peaks already removed in the recording an amplifier capable of 60–80 watts will handle the requirements of lifesize orchestral reproduction of most compositions. This power would produce an acoustic peak power of 10 watts from the Wharfedale loudspeakers used.

We were able to make a measured check on our calculated levels with the cooperation of the B.B.C. and E.M.I. During the broadcast performance of a full choir and orchestra from the Festival Hall, the B.B.C. marked the musical score with the sound levels picked up by their auditorium microphones, and at the same time E.M.I. recorded the broadcast performance. At a following rehearsal we played the recording at what we thought was natural level and the B.B.C. again checked the levels at the auditorium microphones. The two measurements agreed will with errors of about 2 db sometimes one way and sometimes the other. This can be accounted for by such factors as loudspeaker directivity. With commercial recordings, of course, we have no such check and we have to rely on judgment of what sounds right.

Equipment

Figure 1 is a block schematic the control portion of the installation which was positioned in the auditorium. A good listening position for the operator is of course essential during rehearsal for the setting of levels and so on, and it was found desirable to remain in the same position for the actual performance.

It will be seen that the equipment including auditorium-to-stage lines is duplicated. This is purely to minimize the risk of possible breakdown and adds much to the peace of mind of the operator.

The line amplifiers are incorporated merely to transfer the impedance to a value of a few ohms. This enables long unshielded cables to be used from box to stage. The line amplifiers in conjunction with the terminating T pad have unity amplification and apart from convenience do not contribute to the performance in any way. For the sake of standardization and interchangeability, standard QUAD power amplifiers are used in this position. The output level to the lines is approximately 21 volts peak.

The tape machines were provided by Columbia who undertook all the recordings for the special live-*vs.*-reproduced

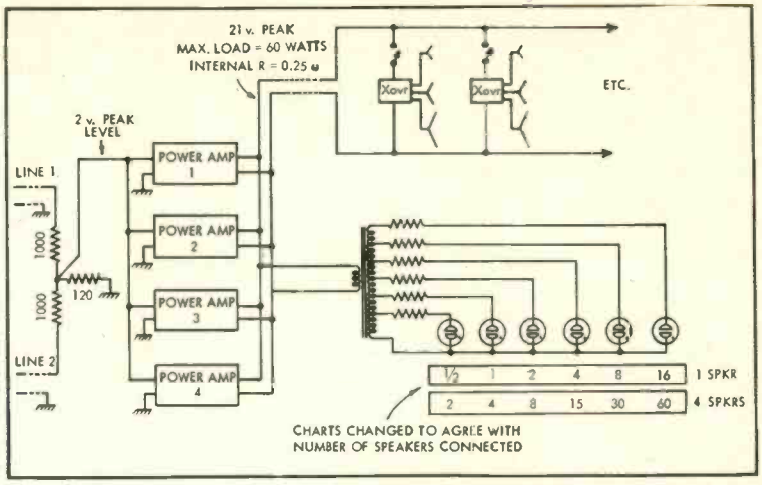

Fig. 2. Block schematic of the amplifier, speaker, and indicator equipment located on the stage.

items. The gramophone equipment comprised Leak and Ferranti pickups mounted on Garrard 301 transcription motors. Tape and pickups were fed into QUAD control units.

Figure 2 is a schematic of the equipment installed on the stage. The two lines are padded down and mixed so that the level of either is restored to the normal output level of the control units. This signal is then fed into four QUAD amplifiers with their inputs and outputs paralleled. They were mounted in the rack shown in *Fig.* 3. Each amplifier is capable of a power output of 15 watts into 15 ohms. This is the English rating and is the power integrated over a complete cycle of a pure sine wave. It is equivalent to a peak of 21 volts. The four amplifiers in parallel therefore will deliver this same 21-volt peak into an impedance of 3.75 ohms.

The conditions necessary for amplifiers to operate correctly in parallel is

(*Continued on page 69*)

Fig. 3. The four standard QUAD amplifiers were mounted on this small rack.

General view of the audience at the Briggs concert in Carnegie Hall.

? ? ? AUDIOCLINIC ? ? ?

JOSEPH GIOVANELLI

Many questions received are common to a number of readers. We'll try to answer all.

Q. I was recently given a speaker by a friend. There was no indication as to what its voice-coil impedance might be. Could you please tell me how to find this out? Arnold Weiss, Brooklyn, New York.

A. Here are three ways that you might try: 1. If you can determine the speaker's manufacturer, together with its model and/or serial number, give him this information. He can tell you its impedance, as well as advise you as to the type of enclosure in which it will work best.

2. If you have an audio oscillator, an ohmmeter, and some means of measuring low-voltage a.c., do this: Place the speaker in some kind of enclosure, since this has considerable effect upon its impedance. Connect the voice-coil leads, potentiometer, and output transformer of your amplifier as shown in *Fig.* 1. In it we see the voice-coil leads connected in series with the potentiometer, and this series combination is connected across the secondary of the output transformer. The potentiometer is connected as a variable resistor, with one of the end lugs not used. Since most speakers have impedances ranging from 3.2 to 16 ohms, a thirty-ohm pot should do nicely here. Connect the audio oscillator to the input of your amplifier, and set its frequency controls to 400 cps. With the signal feeding the speaker, connect your a.c. voltmeter first from A to B, and then from A to C as shown in the figure. Adjust the potentiometer so that the two voltage readings remain equal as you change leads back and forth. Next, disconnect the pot from the circuit, being careful not to disturb its setting. Read its resistance with your ohmmeter. This will be the approximate impedance of the speaker, since we can consider the impedance as a pure resistance. In a series circuit (which we have here), only when the resistances are equal can the voltage drops across them be equal. Of course, there is also a third impedance present, that of the secondary of the output transformer, which at a quick glance, might appear to be a factor here. However, this is not the case. We need only be concerned with there being equal voltage drops across the voice-coil and the pot. The impedance of the secondary will determine only the voltage reading on the meter, but cannot influence the setting of the pot needed to obtain equal readings across it and the voice-coil.

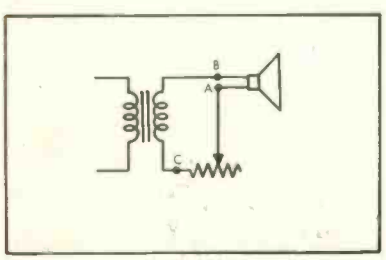

Fig. 1

3. The last method is little more than a guess, but it can be used where there are no measuring instruments available. Simply feed a signal source of high quality, such as a record player or FM tuner, into the amplifier. Connect the speaker in turn to the various taps of the output transformer until one is found which gives maximum output and response as noted by ear. The impedance of the tap to which the speaker is connected will be in the vicinity of true impedance of the speaker. However, since considerable mismatch can be tolerated without substantially affecting performance, it is quite likely that you will not have determined the impedance quite so accurately as when following steps A or B.

Q. What causes the output tubes in an amplifier to glow red? Arthur Darrow, Albany, New York.

A. This indicates serious trouble, and should be corrected at once in order to prevent damage to the output tubes, output transformer, and/or other components. This condition indicates that these tubes are drawing excessive plate current; this can be caused by several things.

1. There may be a complete lack of or insufficient bias on the tubes, due to trouble in the bias supply or a shorted cathode resistor.

2. There may be a shorted coupling capacitor which feeds the grid of one of the tubes. In this case it is likely only one of the tubes would glow red, especially if the system uses a resistor from cathode to ground to develop bias. When the tube with the shorted coupling capacitor draws excessive current (when positive voltage from a previous stage is applied to it), it causes a large voltage to be developed across the bias resistor, tending to reduce the plate current in the other tube.

3. There may be an internal short between elements of one of the tubes. For instance, if the control grid were shorted to the screen, a large amount of current would flow, because there would no longer be a negatively-charged element in the tube to repel electrons.

Q. What is the difference between moving coil pickup and a variable reluctance pickup? Ralph Hastings, New York, N. Y.

A. When a coil is placed in a magnetic field, anything that changes the strength of that field will cause a voltage to be developed across the coil. The moving coil pickup is just what its name implies. The coil is attached to the stylus assembly, so that when the modulation on the disc moves the stylus, the coil moves in and out of the magnetic field. This action develops a voltage across the coil which varies in accordance with the modulation on the disc.

As in the case of the moving coil pickup, the variable reluctance type also depends on some means of varying the strength of the magnetic circuit to produce a voltage. The impedance to the flow of magnetic lines is called *reluctance*. If we design a magnetic circuit in such a way that the magnetic lines must flow some of the distance back to their starting point through air, we have created a circuit of comparatively high reluctance. If we substitute iron for some other magnetic material for the airgap, we have considerably decreased the reluctance, or in other words, have made it easier for lines of force to flow in the magnetic circuit. In the variable reluctance pickup there is an airgap in the magnetic circuit. The stylus assembly is placed in that gap, and is made of magnetic material. When the modulation of the grooves on the disc moves the stylus assembly in and out of the airgap, the field changes strength in accordance with that modulation.

Q. What is the cause and cure for "motorboating" in an audio amplifier? Joel Shurgan, Brooklyn, N. Y.

A. "Motorboating" is caused by unwanted mutual coupling between stages via the power supply. When the phase relation of one stage to another is just right, the stages involved will act like a multivibrator and oscillate, or "motorboat." To prevent this, a filter network consisting of a resistor and capacitor is used. (See *Fig.* 2.) These components are labeled R_D, and C_d respectively. The resistor tends to oppose the flow of the undesired energy through the power supply, while the capacitor makes it easier for the undesired energy to go around the power supply than through it. This trouble is most often caused by no decoupling capacitor at all or by one whose capacitance is too small. If this trouble has occurred only after the amplifier has been in service for a considerable period of time,

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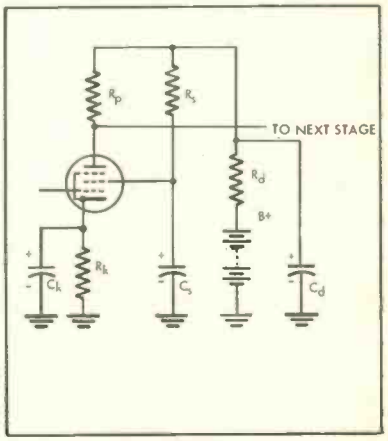

Fig. 2

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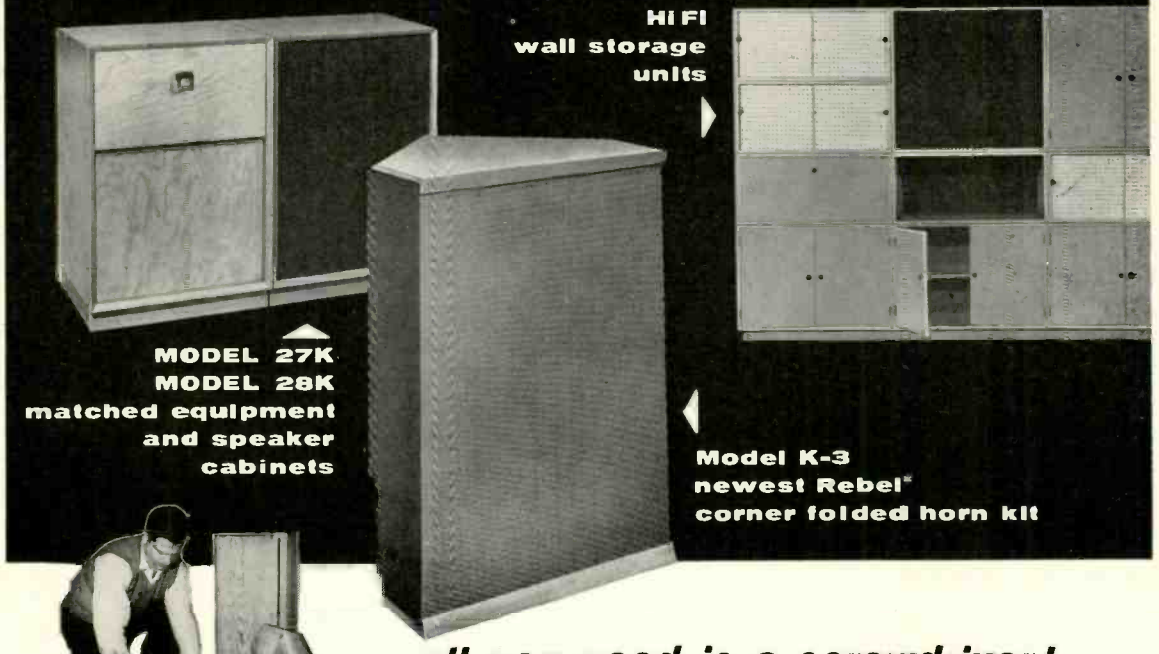

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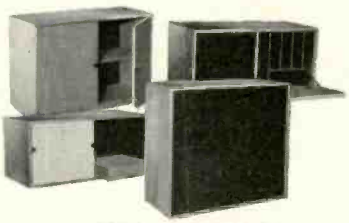

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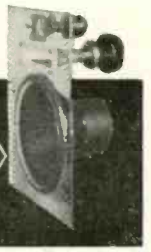


Uses and Abuses of the VU Meter

OLIVER BERLINER*

Since its introduction in 1938, the standard volume-unit meter has been the subject of great misuse. Here is a guide to the understanding of its correct operation.

AT THE OUTSET, it is important to point out that this article does not necessarily advocate the volume-unit meter as the ideal device for sound-level measurement; rather, it is merely an outline of the applications and limitations of the instrument.

Since audio program waves are essentially non-periodic and complex in nature, they cannot be expressed in simple terms of power, current, and voltage. Consequently, the term "volume" provides a means of measuring, defining, and standardizing the extent of complex audio information. Once a reference level has been established, the difference in decibels between the level of any wave and that of the reference level may be ascertained. The VU is defined as the relative strength in decibles from a reference level of 1 milliwatt fed into 600 ohms.

This brings us immediately to the crucial point of the entire situation, the term "standard VU meter". This encompasses many things—meter impedance, line impedance, attenuators, scales, reference level, ballistics, frequency response, and method of reading. But briefly, it means that for a meter to function as a "standard VU meter", it must be built, installed and used according to a prescribed set of conditions; and violation of any of these defeats the purpose of the meter.

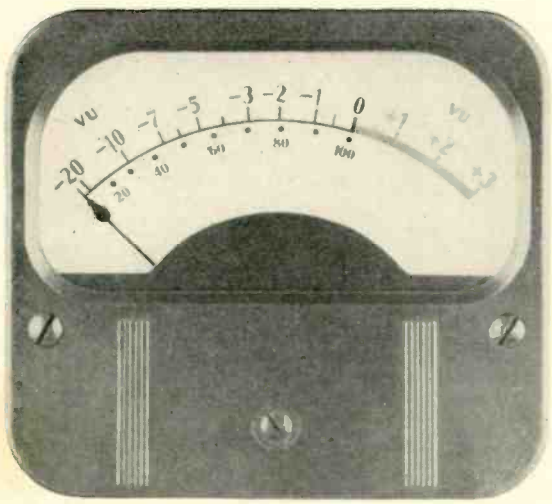
* *6411 Hollywood Boulevard, Hollywood 28, Calif.*

In 1938 the VU meter was born, principally because by that time the growth of the radio broadcasting industry made apparent the need for one standard visual monitoring device. Working with officials and engineers of the National Broadcasting Company, Columbia Broadcasting System, and the Bell Telephone Company, the Weston Electrical Instrument Corporation (to whom this writer is indebted for the photographs, circuits and charts used in this article) assumed the tremendous task of building a standard device that was acceptable to all. (Whether or not this latter point has been achieved will be discussed later.)

Upon examination of the following standards pertaining to the meter, the reader may be amazed at the extent to which the matter of volume-indicator standardization has been carried; but all this is necessary to the establishment of a device which will have universal acceptability, compatibility, and—most of all—reliability.

Carefully controlled damping and speed are prime contributors to the effectiveness of the meter. Pointer overswing is limited to not more than 1.5 percent, while the time taken to reach within 99 percent of final indication shall be 0.3 second, plus or minus 10 percent.

Tight characteristics such as these never existed in the case of the old db meter, where overswing and speed varied from manufacturer to manufacturer, and from meter to meter. Probably the largest group of holdouts against the VU meter was that of the motion picture sound recordists. Their complaint was that the action of the VU meter was too slow, which resulted in their having great difficulty in catching sound peaks,



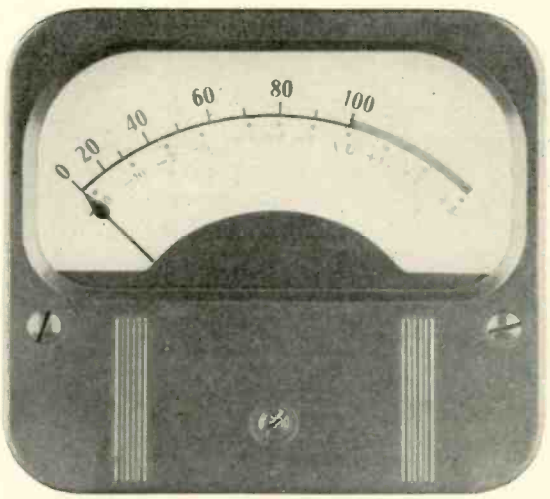
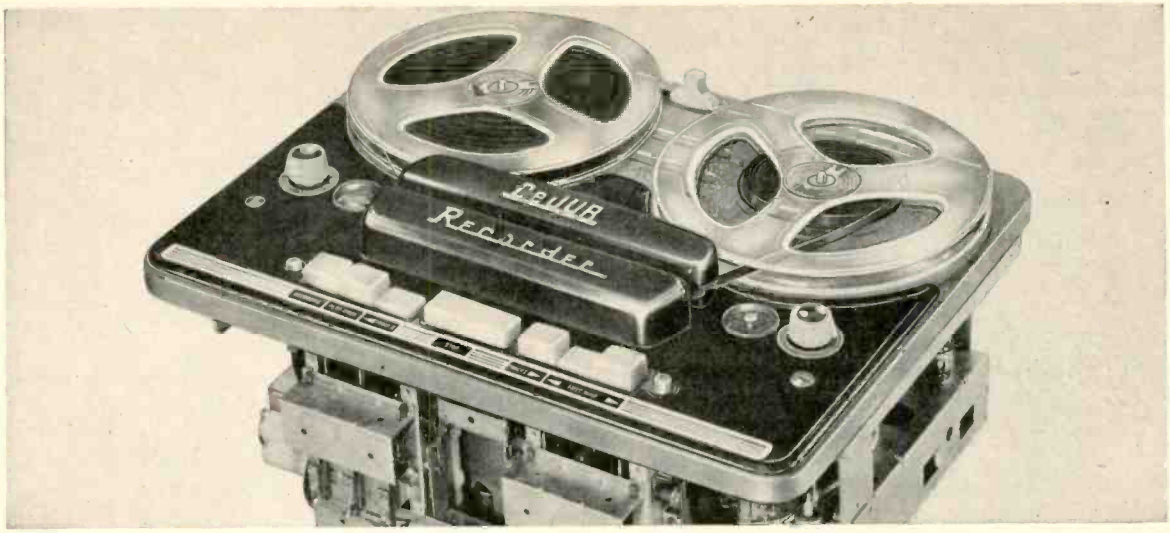


Fig. 1 (left). Type 30 Weston Model 862 VU meter with "A" scale for ease in measuring and testing. Fig. 2 (right). Type 30B meter with predominant percentage modulation scale designed for program line monitoring.



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At 7½ ips, the frequency response is 40 cps to 16,000 cps ± 2 db (the closest comparable machine is 1,000 cps *less* and $100 more!) Even at 3¾ ips, the DeJUR Dual Professional is flat from 50 cps to 10,000 cps ± 2 db.

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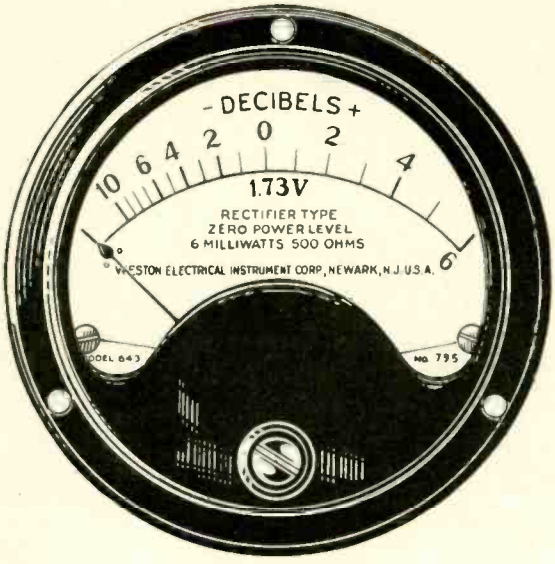

Fig. 3. Model 643 db meter. Note how much smaller percentage of scale area is usable and also the restricted dynamic range.

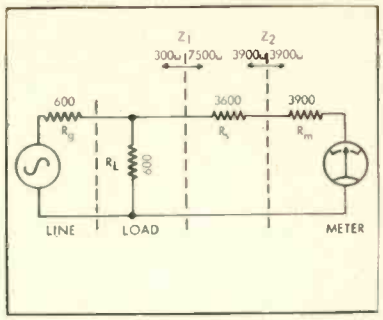

Fig. 4. Basic VU meter circuit. Pointer will indicate zero VU 600-ohm line level of 1.228 volts, which is 4 db above 1 milliwatt.

especially when scoring a picture. As a result of this, they even went to the trouble and expense of purchasing and installing extra-high-speed db meters, not to mention the unique neon-light indicator system of RCA's which uses no mechanical parts, and has the speed of light and a virtually limitless dynamic range.

There is no doubt that fast peaks elude the pointer of the VU meter. Although the motion picture industry only recently has seen fit to adopt the VU meter, it is already talking of changing the standards pertaining to its dynamic characteristics. To a certain extent you can't blame them especially where problems of cueing and of overloading are so critical.

Physical Characteristics

A quick look at a VU meter brings to our attention its scale calibrations. Whereas the old db meter was calibrated from minus 10 to plus 6 decibels, with an operating range of 10 db, the VU meter has a scale of from minus 20 to plus 3 decibels, with an operating area of fully 20 db. A substantial increase in the monitoring of dynamic range, so important to high fidelity, is now possible.

VU meter scales customarily contain two calibrations—the regular VU indications, and a percent usage (modulation) calibration. Scales having the VU markings on top are called "A" scales (*Fig.* 1); and those with per cent usage (proportioned to a.c. voltage) predominant, "B" scales (*Fig.* 2). Unfortunately, some manufacturers of mixers and recorders supply meters with "A" scales. But when we stop to consider just how the meter is used, we realize the fallaciousness of this, for rarely do we use the VU scale. Rather, we try to keep the pointer from going beyond the 100 per cent mark, and we have neither need, time, nor ability to take VU readings during normal program service. The type "A" scale with the VU predominant should be confined in its usage to response and gain measurements, and other testing.

Figure 3 shows an old-style db meter. Comparison between it and *Fig.* 1 reveals the obvious fact that the operating area of the VU meter also makes more use of the scale than does the db meter. Where the db meter uses less than 50 per cent of the scale under normal operating conditions, the VU meter uses between 67 and 75 per cent of the scale area. Coupled with a slightly slower action and the almost-standard buff-colored scale, the VU meter is far easier to read and far less fatiguing than its predecessor.

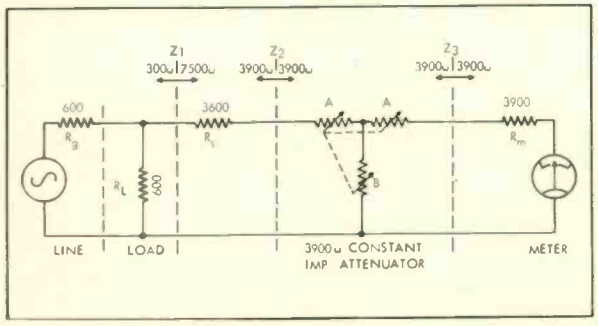

Fig. 5. VU meter range extending circuit for use on 600-ohm loaded line. Critical impedance matching is maintained in every part of the circuit.

Returning to the instrument's ballistic characteristics, the extreme care necessary in its manufacture is apparent when we consider that it must have high current sensitivity to obtain high torque for rapid attack; but it must also have high flux in the air gap for closely controlled damping. These matters of flux, inertia and torque are interdependent, and all must be considered in their relation to each other.

Probably the greatest single violation of standard meter usage occurs in the case of the range extender, wherein users feel that the insertion of a voltage dropping resistor is all the attenuation necessary. For the proper understanding of the VU meter circuitry, we refer to *Fig.* 4

The VU meter was designed for use only on a 600-ohm line, however it may be matched to lines of other impedances as will be shown later. The resistance of the meter at the 0-VU point on the scale is 3900 ohms at 1000 cps. Since it is a rectifier instrument, its resistance varies along the scale, being lowest at full scale. Incidentally, the frequency response of the meter is plus or minus 0.5 db between 25 and 16,000 cps.

Good engineering practice dictates that the impedance of a bridging device should be not less than 12.5 times the impedance of the line being bridge, so that there will be minimum loading and resultant distortion. Multiplying 600 by 12.5 we obtain a product of 7500 ohms, and since the resistance of the meter is 3900 ohms, an external 3600-ohm resistor is required to give us the minimum bridging impedance. An insertion loss of only 0.4 db results with distortion of less than 0.2 per cent.

In audio the practice of matching line to load is always desirable. Consequently, if the resistance of the meter is 3900 ohms, it must "see" 3900 ohms. Examination of *Fig.* 4 shows that it does; for the effective impedance of the loaded 600-ohm line is 300 ohms. Adding

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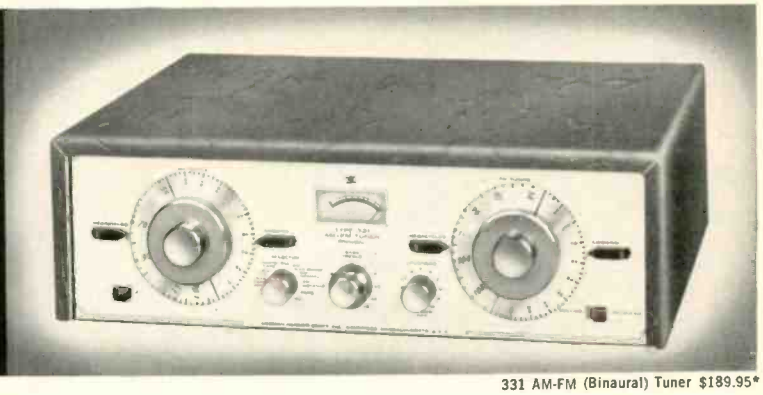

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the 3600-ohm resistor brings us a total of 3900 ohms, which is exactly the resistance of the meter.

The VU meter, therefor, is always used in conjunction with a resistance which not only allows the meter to "see" its own resistance, but which also provides the necessary total bridging resistance to the line. When used with a 3600-ohm series resistor across a 600-ohm line, the meter will indicate 0 VU when the line generates 1.228 volts, alternating current. This corresponds to +4 VU, and is the lowest peak line level capable of being read on the standard VU meter when used in the standard manner.

TABLE 1

Attenuator Loss — DB	LEVEL VU	Arm A Ohms	Arm B Ohms
0	4	0	Open
1	5	224.3	33801
2	6	447.1	16788
3	7	666.9	11070
4	8	882.5	8177
5	9	1093	5221
6	10	1296	5221
7	11	1492	4352
8	12	1679	3690
9	13	1857	3166
10	14	2026	2741
11	15	2185	2388
12	16	2334	2091
13	17	2473	1838
14	18	2603	1621
15	19	2722	1432
16	20	2833	1268
17	21	2935	1124
18	22	3028	997.8
19	23	3113	886.3
20	24	3191	787.8
21	25	3262	700.3
22	26	3326	623.5
23	27	3384	555.0
24	28	3437	494.1
25	29	3485	440.0
26	30	3528	391.9
27	31	3566	349.1
28	32	3601	311.0
29	33	3633	277.1
30	34	3661	246.9
31	35	3686	220.0
32	36	3708	196.1
33	37	3729	174.7
34	38	3747	155.7
35	39	3764	138.7
36	40	3778	123.7
37	41	3791	110.2
38	42	3803	98.21
39	43	3813	87.53
40	44	3823	78.01
41	45	3831	69.52
42	46	3839	61.96
43	47	3845	55.22
44	48	3851	49.21
45	49	3857	43.86
46	50	3861	39.09

What, then, of the old "zero level" line? To say that it no longer exists as such, and that it is a hand-down from the days of the db meters is probably the best answer. One broadcast engineer says that the average program level is 4 db below peaks; and since peaks are plus 4 VU by definition, average program material would be 0 VU . . . zero level.

Although the minimum peak program level readable on the meter is +4 VU, it is frequently necessary to monitor lines of higher levels, particularly broadcast loops of +8 and +12 VU peaks. So as not to overdrive the meter, additional attenuation in its circuit must be provided, but merely to increase the value of the 3600-ohm series resistor is not the answer, for this would disturb the ballistics and damping of the meter.

The problem solves itself nicely with the insertion of a 3900-ohm constant-impedance T pad as shown in *Fig. 5*. Under this arrangement, the meter "sees" 3900 ohms, the attenuator "sees" 3900 ohms both in and out, and the line is still bridged by 12.5 times its impedance, or 7500 ohms. The resistance values for the various parts of the attenuator for lines up to 32 VU in level are given in Table 1. Note that the minimum peak level, obtained with the attenuator completely out of the circuit, but with the 3600-ohm resistor remaining, is +4 VU.

Reading the VU Meter

The standards even go so far as to state the method of reading the VU meter, and of setting its associated variable attenuator. Briefly, the procedure involves observing the action of the meter for about a minute (in the case of program waves) or a lesser time (for speech) and setting the attenuator at the place that allows the meter pointer to remain just under 100 per cent, except for an occasional peak. This procedure, of course, is second nature to all audiomen, but is mentioned here to indicate the great degree to which the standards have been carried.

They also point out that the meter shall have complete reversibility as far as hookup is concerned; that is, no polarization. This feature is obtained through the use of a direct current meter with a full-wave copper-oxide rectifier. Even the scale card has an official color number, Munsell 2.934 (9.18/4.61) although this is not a standard as yet. It is also customary to print the scale beyond the hundred per cent point in red —the danger area, you might say.

Since the VU meter should be capable of handling substantial amplitude variations, a good meter should be capable of sustaining, without any damage whatsoever, a continuous overload equal to five times the reference voltage and a momentary overload of ten times that voltage.

Speaking of voltage, an alarming misuse of the VU meter has appeared in the tape recording industry, where it has been the practice of certain equipment manufacturers to supply vacuum tube voltmeter circuits, using non-volume indicating meters but with VU scales attached. The purpose of this is to save cost, of course; but while this is certainly commendable, it is also exceedingly dangerous. The reason is simple: vacuum tube voltmeters do not have the (necessary) ballistic characteristics inherent to the VU meter, with the result that readings made on such an instrument will not be comparable and interchangeable with those made on a standard VU meter. Since this completely defeats one of the prime features of the VU meter—its dynamic characteristics—recorders utilizing vtvm-type circuits should not use VU scales nor be advertised as having a VU meter.

(*Continued on page 76*)

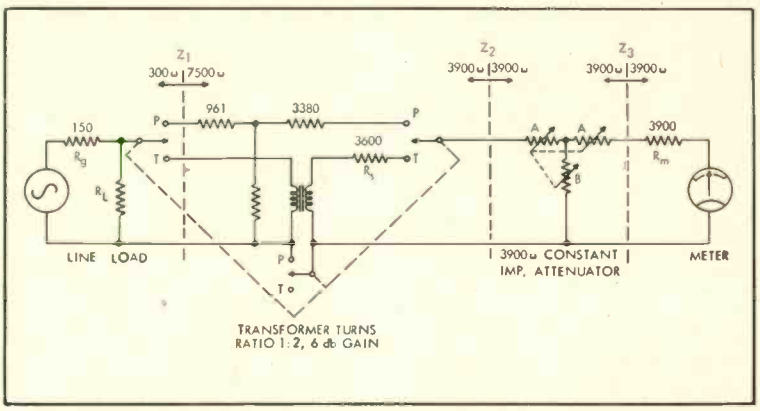

Fig. 6. Method of connecting VU meter to 150-ohm line through matching transformer. Fixed pad is connected at 16-VU point due to power limitations of transformer.

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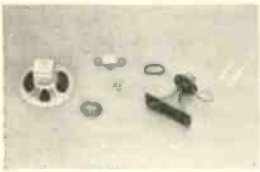

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EDGAR VILLCHUR*

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SOUND—Chapter 2

IT MIGHT APPEAR that following a discussion of the nature of sound, the logical subject to consider next would be the criteria for reproducing this sound with "high fidelity" to the original. One other element, however, should be covered first—the way in which we hear.

We have already seen, in examining units of measurement for pitch and power—the octave and the decibel—that our perception of sound does not necessarily correspond directly to the objective reality. The illusion is consistent, however, so that a given sound always has the same effect on a normal ear.

An important element in the perception of sound was discovered by Fletcher and Munson in 1933. These investigators demonstrated that our impression of loudness did not depend solely on the amplitude of the sound wave, but on other things as well. Specifically, they showed that sound in the lower treble range of the frequency spectrum—the 3500-cps region—appeared to be much louder than sound of the same amplitude at any other part of the spectrum. Thus, if the frequency scale were swept by a tone which continuously rose in frequency but kept exactly the same amplitude, the *loudness,* or apparent amplitude, would increase to a maximum at about 3500 eps and then fall off again.

This fact does not have much practical interest for the person listening to reproduced music, except as it describes the relative nuisance value of different types of noise. No matter how lop-sided our interpretation of acoustic reality, we make the same interpretation in the concert hall as in our living room, and the craftsmen who designed musical instruments (who worked to satisfy their ears, not sound-level meters) perceived sound in the same way.

Fletcher and Munson made a second discovery, however, that does bear directly on the reproduction of sound. They found that the effect described above took place in varying degree, depending on the over-all level of the sound. For very high amplitude sound the drop in loudness with frequency below 3500 eps hardly occurred at all, while for very soft sound the effect was maximum. Above 3500 eps the effect remained constant, within 2 or 3 db, no matter what the over-all sound level.

The well-known "equal loudness contours," also referred to as the Fletcher-Munson curves, are reproduced in *Fig.* 2—1. Each curve plots the sound amplitude required to produce the same perceived loudness at different frequencies of the scale. It can be seen that normal hearing losses in the bass end become progressively greater as the over-all sound level is decreased.

This means that if an orchestra plays a musical passage at the sound level represented by 90 db, and if this music is reproduced at the 60 db level, below 300 eps or so we will hear the bass with less *relative* loudness than we would have heard at the concert itself. If you follow the 90- and 60-db curves, shown superimposed in *Fig.* 2—2, you will see that there is approximately a 14 db perceived loss at 50 eps—it takes 14 db more of actual amplitude, in the lower curve, to produce the same relative loudness at 50 eps as it does in the upper curve.

In order to re-create the original balance of perceived frequencies at low volume levels, it has become customary to introduce bass boost which is related to the setting of the volume control, either automatically or otherwise.

A volume control tied to automatic bass boost is called a *loudness control.* (Some loudness controls also hoost the treble spectrum appreciably at low volume settings. Whatever the justification for this, it does not lie in the Fletcher-Munson curves.)

We are now prepared to discuss the technical standards of quality that may be applied to a sound reproducing system. There will be no dividing lines proposed, at which low fidelity becomes medium, high, or super. Previous attempts have been made to establish such categories, in terms of "frequency range," but the writer considers these attempts to be invalid. "Frequency range" is a completely inadequate way to describe the frequency response of a system, let alone its overall quality.

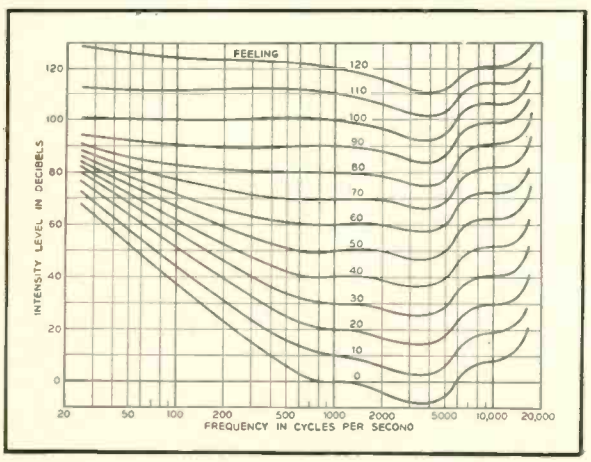

Fig. 2—1. The Fletcher-Munson equal loudness contours. The height of any curve at each point represents the sound amplitude required to produce the same subjective loudness as at 1000 cps. (After Fletcher and Munson)

Frequency Response

The frequency response of a sound reproducing system, or of one of its components, describes its relative handling of parts of the input signal which differ in frequency. "Handling" may refer to electrical amplification, as in an amplifier, to conversion of mechanical to electrical energy, as in a pickup, or to conversion from electrical to acoustical energy, as in a loudspeaker.

There are two aspects of frequency response: the *range* of frequencies handled, and the *uniformity* with which the unit or system responds to different frequencies. Knowledge of the first of these is useless without knowledge of the second. Let us therefore pass over the ques-

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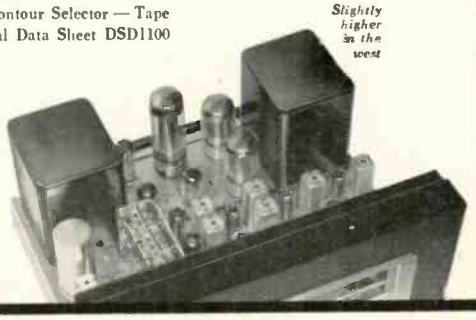

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tion of range for the moment, and determine what uniformity will be required for the range we finally decide on.

Uniformity of Response

Although the trained ear can usually perceive a change of sound level of a db or less in test signals, the average observer is probably less sensitive to a change of sound level in a particular frequency range of a musical passage. Reproduction which remains constant over its frequency range within one or two db would thus probably be adequate for perfect apparent fidelity, other things being equal.

This standard can be met in amplifiers without much difficulty, even at high power levels. The best pickups are also able to conform, but loudspeakers are laggard in this respect. Until recently the best acoustic uniformity that could be expected was of the order of ± 5 db. Recent developments in both "woofers" and "tweeters" have worked to narrow these tolerances.

The results of non-uniform reproduction are several. Undue volume in a particular section of the sound spectrum can produce stridency or boominess as opposed to natural musical sound. More particularly, the existence of sharp peaks in the response curve, usually representing a resonant condition, mean that *hangover* or *ringing* will be present —the speaker cone or section of cone will continue to vibrate after the signal has stopped. This is perceived as a "rain-barrel" effect, a muddying up of the sound and impairment of the distinctness of the different instrumental voices. Such an effect is also indicated when the listener is unable to distinguish the pitch of low-frequency tones.

Another important effect of peaked frequency response is the exaggeration of unwanted noise components such as turntable rumble or record-surface scratch. This effect was not given its due recognition in the earlier days of high fidelity, when the existence of rumble and surface noise was proudly displayed as evidence of extended frequency range.

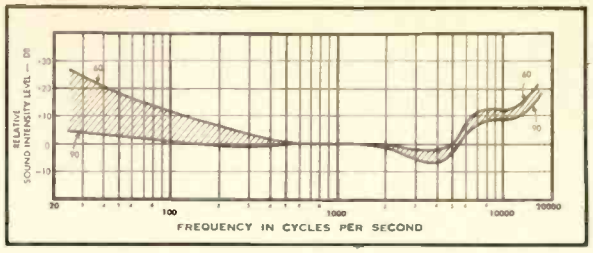


Fig. 2—2. The 60 and 90 db Fletcher-Munson curves superimposed. The shaded area represents the difference in normal hearing loss from one sound level to the other.

It is the writer's opinion that the amount of surface noise in a good quality modern LP record and the amount of rumble from a good, modern record changer, are such that there will not be too much significant noise produced in a system with uniform frequency response, even though the frequency range be extended to the limits of the present state of the art. In a comparison test conducted recently between two tweeters, the one which was able to reproduce almost an octave more of treble (into the inaudible region) showed a dramatic decrease of surface noise, due to its extreme evenness of response. There was no selective reproduction of discrete frequencies, and the switch to the superior speaker produced a fuller, more natural treble simultaneously with the reduction in surface noise.

A similar situation exists with regard to turntable rumble. A peaked system whose response falls off rapidly below 60 cps will normally exhibit more turntable rumble than a smooth system whose full response extends an octave lower.

Tell-tale evidence of the existence of peaked reproduction in the bass may be gathered from listening to the reproduction of speech program material. The male speaking voice ordinarily contains no sound components whose frequency is below 100 cps, and the reproducing system should give no hint (by a boomy, resonant quality in the voice) that it is also capable of speaking in the tones of the double bass.

It is generally agreed among acoustic authorities that the range of 40 to 15,000 cps is sufficient for perfect or near-perfect apparent fidelity in the reproduction of orchestral music. The phrase "near-perfect" is meant to imply that when such a range has been achieved the designer should direct his attention to inaccuracies of reproduction more gross than are associated with the frequency limitations indicated. The frequency range of different musical instruments, including both fundamental and overtone sound components, is illustrated in *Fig.* 2—3.

For the pipe organ enthusiast, however, there is significant intelligence (significant, that is, from the point of view of the emotional impact of the music) down to 32 cps or lower. 32.7 cps is three octaves below middle C relative to *A*-440, and is the lowest note of the average pipe organ, although many larger organs reach down an octave lower. These low organ tones are distinguished by the fact that they contain a strong fundamental component. The lowest tones of the piano, on the other hand, contain no fundamental energy that significantly affects the quality of the sound. Even though the lowest key on the piano strikes 27.5 cps, reproduction down to this frequency is not required.

Probably no characteristic of audio components is so freely booted about by advertising copywriters as frequency range. Any numerical range of frequencies listed is totally meaningless unless accompanied by a description of the decibel tolerance above or below reference that is being used. A 3-inch speaker made for portable radios will "respond" when stimulated by a 30 cps signal—perhaps by having its cone tear loose and fly out into the air—and almost any speaker, even a woofer, will make some kind of sound when stimulated by a high-powered 15,000-cps signal. A frequency response rating must mean something more than that a signal of given frequency makes a speaker move audibly, or that it makes an amplifier show an electrical output of some sort at its terminals. It must mean that within a stated frequency range, and, for power devices, within a stated range of power, the fundamental output of a given device is uniform to a stated degree.

The on-axis response of a loudspeaker may be very deceiving, because the

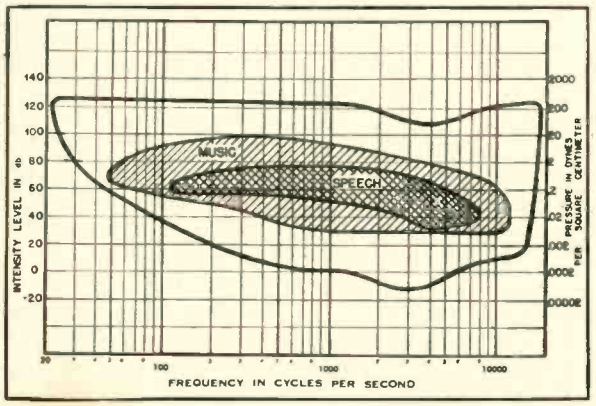
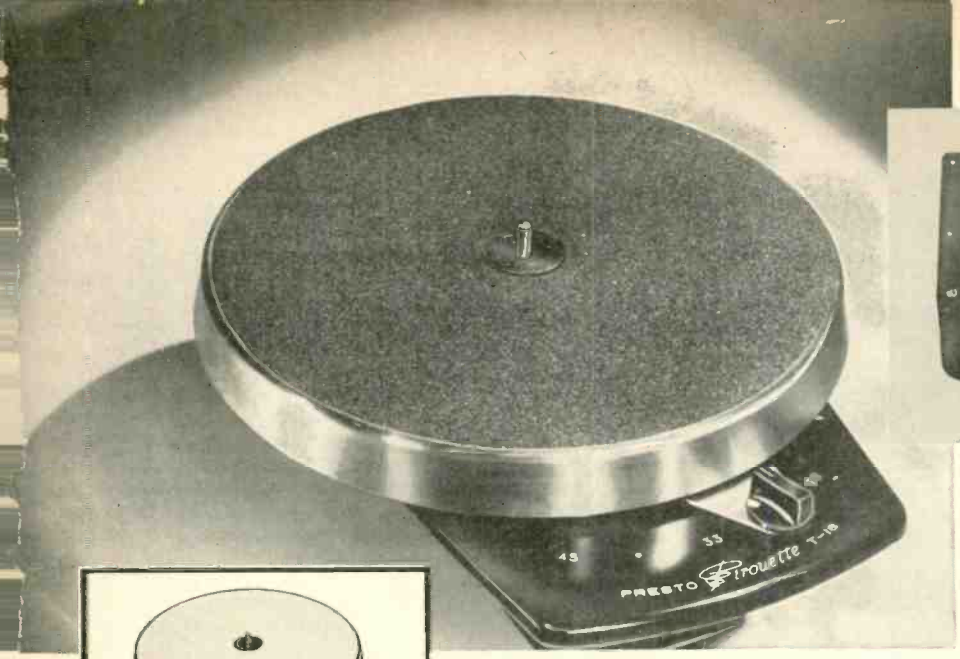


Fig. 2—3. Frequency range of various musical instruments, not including the pipe organ. (After Snow)



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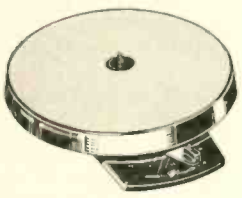

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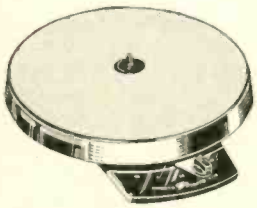

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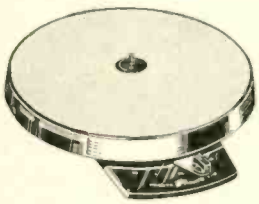

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higher frequencies tend to be directed in a beam which continually narrows as the frequency is raised. Good sound dispersion must therefore be a qualifying factor for any treble response curve.

Transient Response

Transient response refers to the accuracy of reproduction of the wave envelope, and is concerned with the reproduction of attack and decay characteristics of the sound. We have seen that uniform frequency response predicts the absence of ringing; if the steady-state frequency response curve does not have peaks, the reproduced sound will not reverberate inaccurately but will die away just as in the original.

Consider, for example, the tone represented in (A) of *Fig.* 2—4. Perfect reproduction would produce an identical wave form, differing perhaps only in amplitude, while poor transient response would be indicated by the hangover that is apparent in (B). The continuation of the reproduced signal after the original has ended may be compared to a color smear on a reproduced painting. The new musical tones which follow may also be inharmonious to the hangover tone, and an effect similar to intermodulation will be created.

Attack time involves the reproduction of frequencies higher than the fundamental. Although a percussive tone may have a low fundamental pitch, the frequency components associated with its steep attack characteristic may be very high. Natural reproduction of a drum beat through a two-way speaker system may thus be accomplished by the "woofer" handling the fundamental tone and its proper decay, while the "tweeter" contributes the sound components that make up the sharp attack.

Reproducing devices have a characteristic way of performing with less than perfect accuracy to the task demanded of them. In addition to the frequencies at which they are asked to vibrate mechanically (or alternate electrically) they introduce new modes of oscillation of their own—and these new frequencies are harmonics, integral multiples of the original frequency. This inaccuracy is called *harmonic distortion*. It is measured as the ratio of the amplitude of the spurious harmonics to the true signal, in per cent.

We have seen that harmonics of fundamental frequencies are produced in any case by musical instruments. Yet small amounts of harmonic distortion produce very unpleasant effects. The sound becomes harsh, unmusical; the bass is wooden and the treble painful.

The primary reason for this is that with harmonic distortion comes an attendant evil—intermodulation distortion. Intermodulation distortion can be described as the introduction of new sound components, at sum and difference frequencies, when tones of two or more frequencies are passed through a non-linear system—that is, a system which creates harmonic distortion. These sum and difference frequencies are harmonically unrelated to the original musical tones. They are musically discordant, and they serve to create raucous, unmusical sound in a degree proportional to their relative strength. The formation of intermodulation products is illustrated in *Fig.* 2—5.

It is also true that certain of the higher harmonics are musically dissonant to the fundamental.

The primary importance of low distortion has always been recognized by audio authorities. It has also become increasingly recognized by the high fidelity public in recent years, after the first flush of excitement over reproducing regions of the frequency spectrum previously untouched. Amplifier manufacturers now feature distortion data over frequency response data; unfortunately it is very rare for loudspeaker advertisements to make any quantitative reference to distortion at all. The reason lies in the fact that while both harmonic distortion and intermodulation distortion (the latter is usually greater by a factor of 3 or 4) can be kept to extremely low values in high quality amplifiers—less than one per cent at rated power—the corresponding values for loudspeakers are much higher. In the octave below 60 cps it is a rare speaker indeed which can hold harmonic distortion, at any appreciable sound level, below the 5 per cent mark over the entire octave, and many speakers produce percentages of distortion in this frequency region five times as great. But the listening results are not as bad as might appear at first glance: speaker response is normally severely attenuated in this lower range, which helps, and there is comparatively little musical material of such low frequency to be distorted.

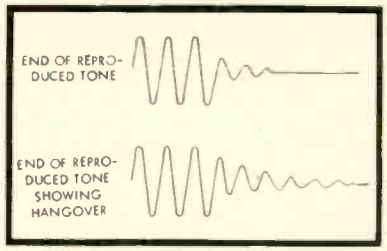

Fig. 2—4. Poor transient response.

When the reproducing system has a minimum of low frequency distortion, very low bass tones of high power, such as might be produced by organ pedal pipes, not only remain pure in timbre themselves but do not create intermodulation with the rest of the music; they do not destroy the purity of the treble by introducing false tones.

The power capability of a high-quality reproducing system should be such as to be able to establish an intensity level of sound in the living room equal to the level at a good seat in the original concert hall. The electrical power required of the amplifier for achieving this goal depends upon the efficiency of the speaker, and the sound power required of the speaker depends on the size and other acoustical characteristics of the room. Concert-hall level can be established in a living room with a tiny fraction of the acoustical power of a symphony orchestra, because the lower power is concentrated in a much smaller area.

"Concert-hall level" is sometimes misinterpreted to mean the sound level which would be created if the orchestra were somehow jammed into the living room itself, and hi-fi demonstrators and fans sometimes vie with each other for prizes

(*Continued on page 76*)

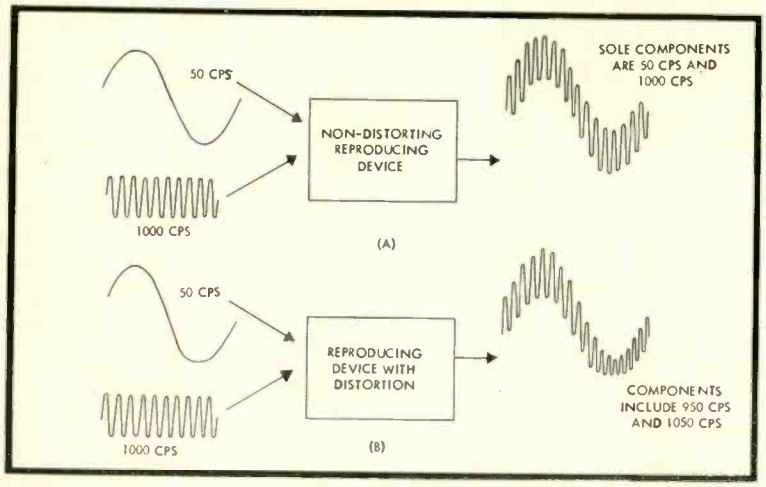

Fig. 2—5. Intermodulation distortion as a result of harmonic distortion of the low frequency wave form. Note that the wave envelope of the high-frequency tone is "modulated."

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Equipment Report

Rauland "Golden Gate" AM-FM Tuner and TV Sound Tuner —New Kingdom-Lorenz Speaker Line—Collaro 2010 Transcription Turntable—Sherwood S-1000 Music Center Amplifier.

COMPARING NEW EQUIPMENT each month invariably serves to provide an education in manufacturers' different approaches to the problem of providing equipment that will do what is expected of it and, in addition, offer some new feature which will at least attract the interest of the prospective purchaser to the extent that he will give it a tryout. And in the case of the Rauland HF-155 "Golden Gate" AM-FM tuner, the manufacturer has done just that. No more or less attractive in appearance than many other tuners, this model might just possibly escape consideration by the shopper without the "gimmick." But with the gimmick at hand in the form of an attachable TV tuner, the unit may be singled out for a trial, and from then on it can well proceed on its own, for it is an exceptionally good performer on every count.

The HF-155 is relatively small, being 4 in. high, 13½ in. wide, and 10 in. deep, and is housed in a black and gold marbleized case. The front has only two knobs—tuning and selector—and an indicator light shows which band is being employed. The selector switch is marked with five designations—OFF, AM, FM AFC, FM, and TV. The tuner sections are fairly conventional, and terminate in a cathode follower to permit feeding a long line to the amplifier. A 5-μv signal will give an output of 1.5 volts on AM, and will provide 20 db of quieting on FM. In actual use on FM, the set seems like a good automobile radio 100 miles from any city—there is a station on almost every channel. For this type of reception it is necessary to operate without afc, for the control is so effective that it will hold a station of good local strength over a range of 1 megacycle each side of the correct tuning point. Frequency response is claimed to be flat within ± 0.5 db from 20 to 20,000 cps, and in comparison with another set known to have this response, it was not possible to detect any difference on a live band program originating locally—a reasonably valid test.

The "gimmick" mentioned earlier is the adaptation which permits the connection of a companion TV tuner for receiving the sound portion of TV programs. A small socket is provided on the rear apron of the HF-155 which furnishes power to the TV tuner—similar in appearance and 7¼ in. wide and 8¼ in. deep—which is simply plugged into the socket. Antenna connections are paralleled between the two units, and when the selector switch is turned to TV, the auxiliary unit feeds the TV sound i. f. (at 10.7 mc) through the FM i. f. section. Because of the wide i. f. pass band, compared to usual TV receivers (which require only ± 25 kc of frequency swing) the sound quality is excellent—even better than from the discriminator of our old 630, which can provide audio quality somewhat above average.

The TV unit consists of a conventional turret-type tuner adapted to work at a 10.7-mc i.f., and provided with a switch in the heater circuit. A fine tuning control permits accurate adjustment of tuning. For installations where the user wishes to use his hi-fi system to reproduce TV sound without the inconvenience of making internal connections to his TV set, this combination of units will give excellent quality. To form a valid opinion of any tuner it is necessary to "live with it" long enough to find out if it "wears well," and after three months of living with these units, it must be said that they do wear extremely well.

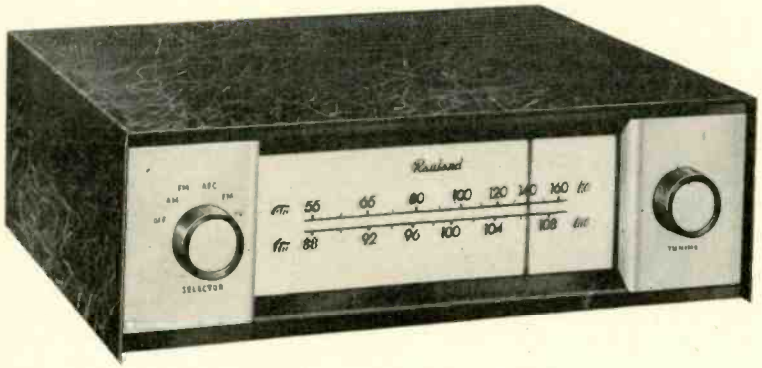

Fig. 1. Rauland "Golden Gate" AM-FM tuner.

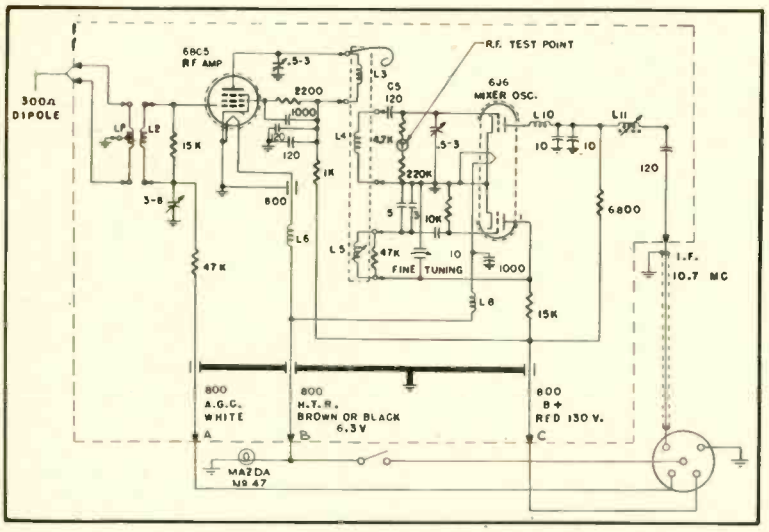

Fig. 2. Schematic of Rauland TV tuner unit.

NEW KINGDOM-LORENZ SPEAKER LINE

Though introduced to the U. S. market only a little over a year ago, the first two models of the Kingdom-Lorenz line have already established themselves for quality above what could reasonably be expected when one considers the cost. Nor, in fact, should these speakers be judged on the basis of cost, for in proper enclosures they perform well. The two models which have been shown over the past year are the LP-215 and the LP-65—8½ and 2½ inches in diameter, respectively. Better to suit standard U. S. enclosures designed for 8-inch speakers, the new LP-208 supersedes the 215. It is heavier, being rated at 15 watts average and 25 watts peak, and is constructed with a cast girder-type basket to eliminate frame resonances. Voice-coil impedance is 8 ohms, and the unit is capable of wide-range output when properly housed. It requires a baffle opening of 7¼ in. and it is 4 in. deep.

The LP-65—a tweeter with a frequency range from 2000 to 17,000 cps—remains in the line. It resembles a cone speaker, but has a solid back so that it may be installed in the same enclosure with a low-frequency speaker without being affected by the air pressure in the enclosed space. For best results this unit should be used with a crossover network at 5000 cps, although a series capacitor will serve to prevent damage from low frequencies. Listening tests always show that quality is better when the network is used so that the high frequencies are not fed to both units with resulting cancellation at various points in the spectrum. The LP-65 has a 5.5-ohm impedance, and is rated at 2 watts, but when restricted to the high-frequency range, it will handle the output of a 25-watt system.

A completely new speaker is the LP-312, a 12-in. model shown in *Fig.* 3. Constructed with a heavy cast girder frame, this unit has a usable frequency range from 20 to

Fig. 3. New Kingdom-Lorenz LP-312—a 12-inch model with cast basket.

14,000 cps, although it is more common to use it as a woofer and add an LP-208 and an LP-65 to cover mid- and high-frequency ranges, or use it with one or two LP-65's in a coaxial mounting (see *Fig.* 6). However, when used alone, it is capable of excellent performance over the entire frequency spectrum.

To facilitate building up from a single 12-inch speaker to a two- or three-way system, the TB-1 and TB-2 tweeter combinations have been added, *Figs.* 4 and 5). With these units, it is possible to convert any 12-in. speaker to a coaxial or diaxial unit simply by bolting one of them in place in front of the larger cone and

Fig. 4. Lorenz TB-1 tweeter combination for 12-in. loudspeakers.

adding either a high-pass filter, type HP-1, or a crossover network. The mounting brackets are of heavy construction and are designed to clear the cone completely. This arrangement eliminates the need for makeshift fittings when it is desired to add a tweeter to an existing speaker, and when installed the result is neat and efficient; and furthermore, it requires a minimum of work.

For those desiring a finished unit employing both the 12-in. woofer and one or two of the tweeters, the LP-312-1 and LP-312-2 are available. These models consist of the basic LP-312 in combination with either TB-1 or TB-2 already installed and connected. The combination gives an increased frequency range — extending to 17,000 cps at the high end and when installed in an enclosure which will permit it, down to 20 cps at the low end.

Various combinations of the Lorenz line have been auditioned, ranging from a single LP-208 to a complete three-way system composed of two LP-312's, two LP-208's and two LP-65's. As would be expected, the six-speaker system was considerably superior to any other speaker played singly, but the over-all quality was considered excellent and more than adequate for a high-quality system. As with any direct-radiator type loudspeaker, the enclosure makes a great difference in the performance, and this observer would recommend that whenever judging loudspeakers before selecting one for use in one's system, the listener should make sure that each successive speaker be tested in the same type of enclosure as that in which it is to be installed. The housing can make considerably more difference than the loudspeaker unit itself, and in most instances can either enhance or degrade the performance of the unit. Some speakers work well in certain types of enclosures and poorly in others, while the results may be completely reversed with another speaker unit. The Kingdom-Lorenz line has consistently shown up well in back-loaded enclosures of the Klipsch Rebel type, yet still sounds well in a bass reflex cabinet. No information is available on performance in infinite baffles, but since low-frequency resonance is relatively low, it is estimated that performance would be satisfactory.

While it has not been possible to make a complete series of acoustical measurements on the entire line of Kingdom-Lorenz speakers, such measurements have been made on some of the models, in comparison with a speaker of known quality and performance (it is not claimed that our testing methods yield absolute response figures for loudspeakers, although the methods do simulate the performance of speakers in the same room with what we consider our "standard"). All of the K-L models have been heard, however, and in most of the possible combinations, and a long period of "living with" the LP-65 in conjunction with the earlier LP-215 has been sufficient proof of the performance of the tweeter—which remains unchanged in the new line. Comparative listening to the new 8-inch model indicates that it is even better than the earlier 9-inch unit in the low-frequency region, and the 12-inch model adds another octave to the low end with smoothness largely dependent on the enclosure—which can be said of any loudspeaker. The new line offers a convenient and practical method of "building up" to a two- or three-way system of good performance.

Fig. 5. Lorenz TB-2—a two-speaker tweeter unit with mounting bracket.

Fig. 6. The new LP-312-2—a combination of the LP-312 and the TB-2.

COLLARO 2010 TRANSCRIPTION TURNTABLE

The Collaro transcription turntables are available in two styles—model 2010 with a 12¾ × 15½ in. base and with the arm mounted integrally on it, and model 2000 with a smaller mounting plate, most of which is covered by the platter itself. Both are similar in mechanical construction, but only model 2010 has been tested.

The base plate is mounted solidly to the motor board with only a rubber gasket around the edges—this mainly to serve as a damper rather than as a vibration isolator. The turntable, an 8½-lb. iron casting, is mounted on a 7/16-in. shaft, and runs in a die-cast well that is fitted with bronze bearings. The heavy turntable provides some flywheel action, since most of the weight is concentrated around its perimeter. The unit requires a clearance of 2¾ in. above the top of the motor board, and only 3 in. below the top of the motor board. The arm is long enough to permit playing 16-in. transcriptions, and the total space required to clear the large discs and the base plate is only 16¼ in. deep by 17¼ in. wide.

The well-balanced motor is hung on three coil springs in tension, and the drive to the turntable is through a thin idler wheel which consists of a steel disc around which has been moulded a rubber wheel, the steel extending to within ⅛ in. of the edge of the idler. A single knob on the front corner of the base plate selects speed and operates the motor switch.

The pickup arm is supported by a Viscoloid "hinge" for its horizontal axis, and rotates in the post which is integral with the base plate. An arm rest is also mounted on the base, and a stop on the arm prevents damage to the stylus if the arm is dropped inadvertently. The pickup furnished is a crystal made by Ronette, and employs the 284PX construction, the "X" signifying a perforated stylus bar which reduces the effective mass to a minimum. The unit tracks with 8 grams, and a 7 cm/sec. signal gives an output of 0.1 volts when terminated by 0.12 megohm. At this termination, the signal is essentially of the constant velocity type, and may be fed into a conventional preamplifier with the usual compensation controls. Some caution should be exercised to avoid overloading the first stage, but this may be done easily by employing a voltage divider at the input. One easy way of doing this is to connect a 75,000 ohm resistor in series with the "hot" lead from the pickup to the input of a usual preamplifier with a terminating resistor of 47,000 ohms.

The two Collaro transcription turntables are normally finished in an ivory enamel, and the platter is covered with ribbed rubber. Using the same methods as outlined in the March issue, the rumble content was measured at a level of 43 db below the output from a disc cut at a level of 20 cm/sec. This is what could be reasonably expected in normal home installations—and in many professional ones—and should not be construed as an absolute measurement. However, let it be said that with normal records playing at normal level rumble was undetectable.

The Collaro models are easily mounted, and could well provide consistent and reliable operation for the user who wishes a single-play turntable.

Even though the Collaro 2010 is a relatively simple unit, its performance can well be said to make it suitable for those who wish a heavy well balanced turntable for quality reproduction.

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Features brand new circuit and physical design. Matches WA-P2 Preamplifier. Modern tube line-up provides better than 10 uv. sensitivity for 20 db of quieting. Built-in power supply.

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$24.50

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Features a new-design Peerless output transformer and KT66 output tubes. Frequency response within ±1 db from 5 cps to 160 Kc at 1 watt. Harmonic distortion only 1% at 25 watts, 20-20,000 cps. IM distortion only 1% at 20 watts. 4, 8, or 16 ohms output. Hum and noise, 99 db below rated output. Uses 2-12AU7's, 2-KT66's and 5R4GY. Attractive physical appearance harmonizes with WA-P2 Preamplifier. Kit combinations:

W-5M AMPLIFIER KIT: Consists of main amplifier and power supply, all on one chassis. Shpg. Wt. 31 Lbs. Express only. $59.75

W-5 COMBINATION AMPLIFIER KIT: Consists of W-5M amplifier kit *plus* Heathkit Model WA-P2 Preamplifier kit. Shpg. wt. 38 Lbs. Express only. $79.50

❸ Heathkit HIGH FIDELITY PREAMPLIFIER KIT

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MODEL WA-P2
$19.75

❹ Heathkit Williamson Type HIGH FIDELITY AMPLIFIER KIT

This amplifier employs the famous Acrosound TO-300 "Ultra Linear" output transformer, and has a frequency response within ±1 db from 6 cps to 150 Kc at 1 watt. Harmonic distortion only 1% at 21 watts. IM distortion at 20-watts only 1.3%. Power output 20 watts. 4, 8, or 16 ohms output. Hum and noise, 88 db below 20 watts. Uses 2-6SN7's, 2-5881's and 5V4G. Kit combinations:

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W-3 COMBINATION AMPLIFIER KIT: Consists of W-3M amplifier kit *plus* Heathkit Model WA-P2 Preamplifier kit. Shpg. Wt. 37 lbs. Express only. $69.50

❺ Heathkit Williamson Type HIGH FIDELITY AMPLIFIER KIT

This is the lowest price Williamson type amplifier ever offered in kit form, and yet it retains all the usual Williamson features. Employs Chicago output transformer. Frequency response, within ±1 db from 10 cps to 100 Kc at 1 watt. Harmonic distortion only 1.5% at 20 watts. IM distortion at rated output 2.7%. Power output 20 watts. 4, 8, or 16 ohms output. Hum and noise, 95 db below 20 watts, uses 2-6SN7's, 2-5881's, and 5V4G. An exceptional dollar value by any standard. Kit combinations:

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W-4A COMBINATION AMPLIFIER KIT: Consists of W-4AM amplifier kit *plus* Heathkit Model WA-P2 Preamplifier kit. Shpg. Wt. 35 lbs. Express only. $59.50

❻ Heathkit 20-Watt HIGH FIDELITY AMPLIFIER KIT

This model represents the least expensive route to high fidelity performance. Frequency response is ±1 db from 20-20,000 cps. Features full 20 watt output using push-pull 6L6's and has separate bass and treble tone controls. Preamplifier and main amplifier on same chassis. Four switch-selected inputs, and separate bass and treble tone controls provided. Employs miniature tube types for low hum and noise. Excellent for home or PA applications. Shpg. Wt. 23 Lbs.

MODEL A-9B
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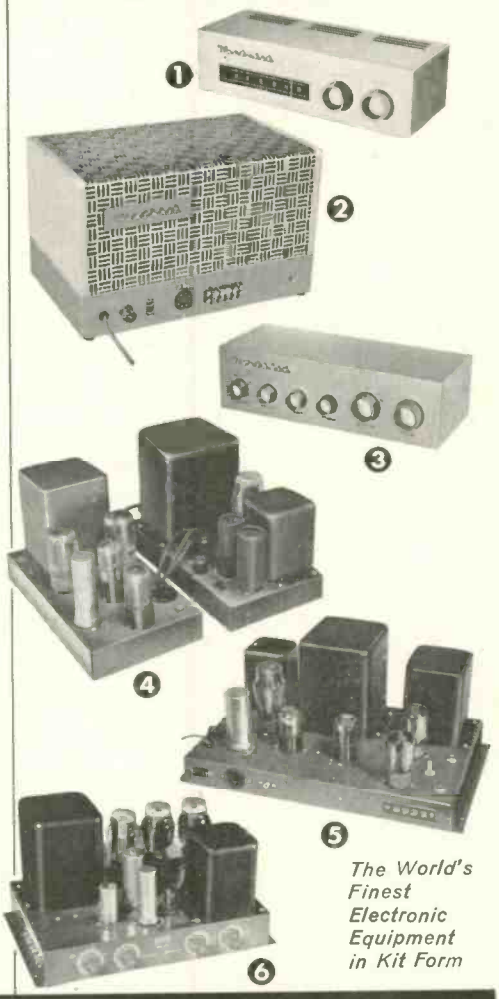

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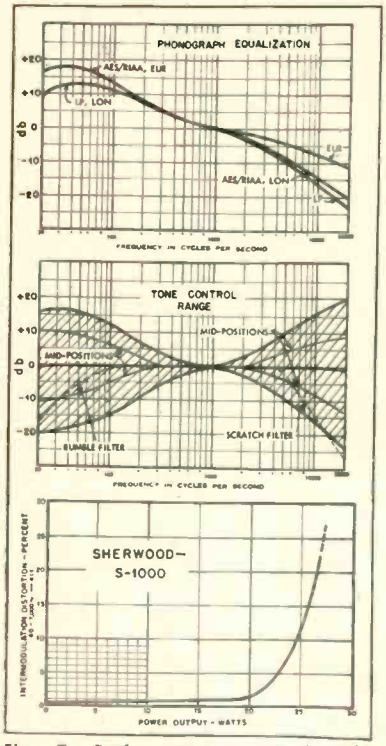

Fig. 7. Performance curves for the Sherwood S-1000.

Fig. 8. Sherwood "Music Center" amplifier.

SHERWOOD S-1000 "MUSIC CENTER" AMPLIFIER

Every so often a particularly attractive unit of hi-fi equipment comes along, not only from the standpoint of appearance, but also from that of performance. The Sherwood S-1000 "Music Center" amplifier is one of them, and some of the circuit design features are of particular interest to those who are technically interested in audio products.

This amplifier is designed for the user who must have compactness—although there is no reason why it should not be just as effective in an installation where space was not a problem. Shown in *Fig.* 8, it is housed in a metal cabinet which is adequately ventilated, and available in black and gold stippled lacquer, or leatherette in mahogany, black, or white. The control panel is framed by a gold-finished bezel, and the panel itself is leatherette in a constrasting color. There are five knobs, four push buttons, and two slide switches on the panel—with a pilot light to indicate when power is turned on.

The four pushbuttons at the left control the phono equalization, and are marked LP, LON, AES/RIAA and EUR, providing the curves shown in the top section of *Fig.* 7. The left knob is the selector switch, with a high-gain PHONO position and four low-gain positions marked A, B, C, and TAPE. The next knob is the bass tone control and the next is the treble control, both of the Baxendall type, and both marked for boost or cut in db. A loudness control is next, with a "normal" point marked on the panel as "0" and the relative levels shown on the panel in db above and below normal. The remaining knob works over three positions—in the counterclockwise position the power is off; in the center power is on and the loudness control is operating normally; in the clockwise position power is on and the equalization is removed from the loudness control so that it operates as an uncompensated volume control. The slide switches control the phono scratch filter and the rumble filter—the latter being operative on all inputs to the amplifier.

The first three tubes are mounted on a sub-chassis which is accessible from the bottom of the cabinet; located on the same chassis are a phono level-set control, tape recorder output jack, and the damping-factor switch—about which more later. The remaining four tubes are accessible from the rear. The five inputs are on the rear panel, and the speaker connections are located on the output transformer shell so as to be reached readily from the back of the unit. Even the auxiliary power receptacle is so mounted as to be out of the way of the output and rectifier tubes. On the whole, the physical and electronic engineering is straightforward and efficient, both internally and externally.

The phono preamp is a low-noise Z-729 pentode feeding one half of a 12AX7, with equalizatiou networks connected between the two plates, and with the phono level-set control following. The selector switch grounds all unused outputs, and feeds the second half of the 12AX7 which serves as a cathode follower to drive the Baxendall tone-control circuit, which feeds the first half of another 12AX7, and this is followed by the loudness control and the second half of the tube. The rumble filter is located between this tube and the 12AU7 split-load phase splitter which drives the two 6L6GB output tubes in an Ultra-Linear circuit. Performance data are shown in the three sections of *Fig.* 7, and the complete schematic is shown in *Fig.* 9.

The Damping Factor control is provided in the form of a switch that has three positions—the center position being normal, while the other two select positive or negative current feedback, with resulting increase or decrease in the damping factor. In the normal position the internal impedance on the 16-ohm tap is 2.3 ohms, or a damping factor of 7. In the "−2" position, the output appears as a negative 8 ohms with resulting increase in the damping. With well damped speaker systems the user may prefer to use the "+2" position, with considerably below-normal damping. In use —to the ear, that is—there is an appreciable difference in output quality when the switch is indiscriminately changed from one position to another, but this is largely due to level change. When the volume is compensated, the difference is more subtle but still there. With small and bass-resonant speakers, the negative position is the best sounding, provided the bass loss from this arrangement is made up with the tone control. In the positive position, the resonant point is magnified, although with a top-quality speaker it is only slightly apparent. With this variety of choice, however, any user should find one position that particularly suited him.

While many amplifiers are designed to be mountable in a cabinet, the method of doing so with the S-1000 is somewhat unusual in that the entire metal housing still serves as protection for the amplifier, as well as shielding. The front panel and the ornamental bezel are removed from the metal case and installed permanently in the wooden cabinet and the amplifier is "plugged in" from the back. Suitable support members are required to sustain the weight of the amplifier, but a minimum of changes is required in order to make it into a unit which looks as though it were installed by a professional, even though the woodworking ability of the builder may not be topnotch.

The S-1000 is physically small, but it performs all the needed functions of a "music center" and has most of the features considered desirable by those who know what they want and who know enough about their requirements to make a valid decision.

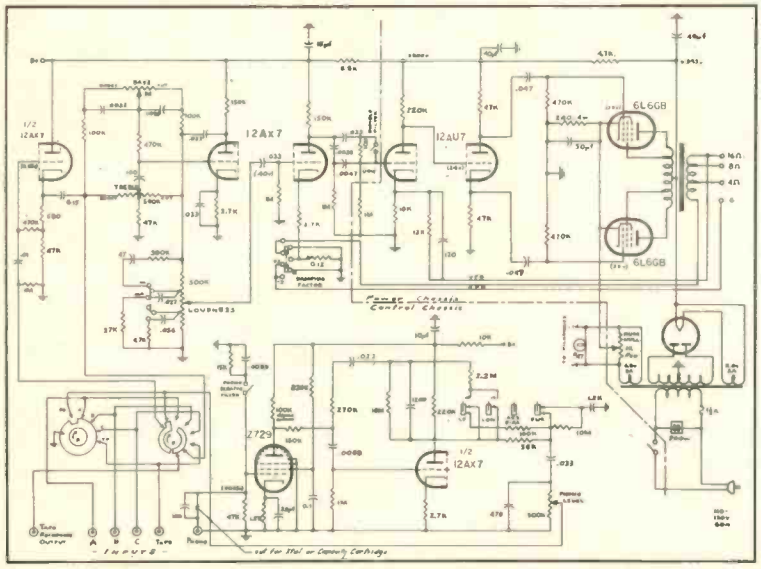

Fig. 9. Schematic of the Sherwood S-1000 "Music Center" amplifier.

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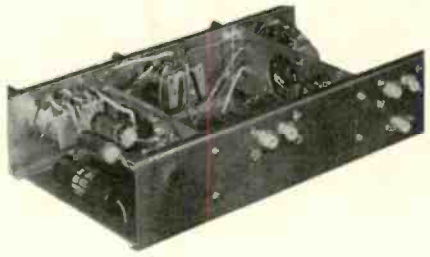
As described by C. G. McProud in the May issue of AUDIO. Three tubes—preamplifier with three phonograph equalization curves, presence control, volume and loudness controls, and Baxendall-type bass and treble tone controls.



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Complete kit of parts, including the basic kit and all other parts and tubes as specified by the author. With complete instructions **$35.50**

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B-305 ..... Net 390.00
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RECOMMENDED, because this machine has been designed to provide the professional user and quality enthusiast with a unit supreme in its class . . . truly the world's finest transcription turntable for use in the home!

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EDWARD TATNALL CANBY*

Mozart-Beethoven

IT'S BEETHOVEN'S 181st YEAR, as well as Mozart's 200th, allowing for the ambiguity of our mystic dating system. (During your first year you are less than a year old; during your 200th, your bones are only 199.) Here are a few current items, in celebration of these numbers.

Beethoven: Piano Concerti #2, #4. Serkin; Phila. Orch. Ormandy. **Columbia ML 5037**

The first of Beethoven's concerti (misnamed Number 2 a long while ago) and the fourth complete all five on records by this team. I haven't the others at hand but remember. I think, being much impressed with Number 5, the Emperor. The present two are really first rate. The dynamic, exciting, always utterly musical playing of the Great Rudolph, the man with the lean face and flying mane who practically propels himself up in the air with the sheer energy of his pianistic muscles, the excellent backing of the Phila., make these "authoritative," as the mealy-mouthed phrase goes, and much more, too—a fresh, honest musical experience.

Trouble with a number of the Phila. Orch. classics on records is the indefinable sense of routine projected, thanks to too many playings on too many ultra-standardized programs of the ultra-familiar works. Maybe the fact that these two concerti, #2 and #4, are less often heard, has a lot to do with these dynamic and untired readings. Musicians are only human! It must be an honest relief to play, for once, a great piece that wasn't played yesterday and the week before and the week before that. I won't attempt to choose between the two—both are immediately, audibly alive in this special sense.

Note a tiny but most significant disagreement between the printed notes concerning #2 and the imprinted interpretation. Of this first Beethoven concerto's first movement, the notes say, right out of somebody's dictionary, "a delicate and Mozartian *Allegro con brio* opens the work. . . ." Now just pull out the record and play the same!

Mozartian, yes, especially in the second theme, which comes after a few moments. But I beg to report, (a) that these days Mozart is no longer considered delicate—indeed, he never was in the sense that too many of us might gather from that word—and (b) the early Beethoven works, including this one, have been wonderfully revalued in recent years; now they are played almost everywhere as though they were real Beethoven—rough, bluff, foursquare, strong-minded, solid in architecture—instead of "delicate" early works, over-influenced by Mozart and Haydn, those poor dears.

So it is, here. The sound is immediately that which we know in later works of Beethoven, and it seems to me that anybody can hear how *right* is is. Not a bit delicate.

You'll find the same thing in the first two symphonies, invariably described in accounts of 50 years ago (and, of course in today's "music appreciation") as delicate and Mozartian. They are full of beans, to put it in modern terms. Also full of Beethoven. After all—he did write them.

Extra note: the cadenza in the first movement of the Second Concerto is here a most interesting one. Instead of the usual hogwash it is a cadenza written by Beethoven himself—in his late years. It has all the characteristics of late Beethoven: a dynamic fugue, driving dotted figures, strange dissonances, piling-up of complex piano counterpoint, long, rumbling pedal points in the bass—and yet it fits this work to a T. Moral: internal architecture, musical engineering, is even more fundamental than outward style.

It would not have been possible for Beethoven to write a cadenza in his "early style," just to suit this concerto, nor would it have occurred to him as desirable in any way (though many a pianist of later times fancies himself quite up to the task). If you want to hear what a real cadenza can do for a concerto—a cadenza that "belongs," is a genuine part of the over-all dramatic and structural sense of the music, style or no—then keep tuned to this one.

Mozart: Symphonies #35 ("Haffner"), #36 ("Linz"). Royal Philharmonic, Sir Thomas Beecham. **Columbia ML 5001**

Best description of this, to those who have followed Sir T. these many years, is—more of the same. Two excellent interpretations, if you go along with "Tommy's" by now familiar approach, that many years ago made him a reputation as a foremost Mozart conductor.

I don't go along myself. Our tastes and preferences have been changing since Sir Thomas formed his own strong ideas. Nowadays, these Mozarts sound, at least to this ear, heavy and overblown, though by no means unmusical. Matter of style. To our ears, increasingly tuned to more flexible and smaller orchestral groups, microphone-aided, the large symphonic sound of these is both familiar and somehow out of date.

Notice especially the Minuet sound, in that slow, "Pomp and Circumstance" sort of tempo that was familiar 20 years ago in Sir Thomas' earlier Mozart 78's, some of which I have around still.

But—let me make a clear distinction between a style of playing and the essential musicality of a performance. Sir Thomas remains a thorough, if somewhat crotchety, musician. His performances will always rank high, his thoroughness, the care with which he shapes details will always please, style or no.

Mozart: Symphony #36 ("Linz")—Birth of a Performance. Columbia Symphony, Bruno Walter. **Columbia SL-224(2)**

Here's a really unprecedented LP release and one that shows real imagination on the part of Columbia's musical management. A simple idea—but who's done it before? This gives not merely a few dramatic samples of conductorial eccentricity, but a complete rehearsal, at long, long length and at leisure, so that one follows not merely the composer's "in-person" impact on the ear but, much more interesting, the actual sense of the rehearsal. Here we can understand, word for word, phrase for phrase, just what is going on, what develops, how the music is shaped up, changed, polished (by a group of players who were of course 95 percent prepared to play the symphony before they even began)—and in the end, we hear the finished product complete.

It takes no less than four LP sides, all this, and that takes nerve, confidence, intelligence and common sense on the part of the promoters of this album far beyond average. We must always admire a project that is done all the way, thoroughly and without hedging and compromise.

In line with this unusual attitude you will find extras here not present in previous "rehearsal" recordings. They add to the business-like usefulness of the album.

The score, complete, and in a reasonably large-size miniature edition (4 pages on each large page of the booklet). And in it, not only all the standard identification points—measure numbers, letters, etc.—but specially marked-in places, where Bruno Walter stops to make a special comment. You just can't get lost.

Clarity. Instead of a muffled and at-a-distance mumbling by the conductor, here Bruno Walter is close-up and completely audible; yet the music sounds very natural and well balanced in spite of Columbia's apology for the compromise in musical pickup that had to be made (with the utmost reasonableness) in order to get the one mike right next to the conductor to pick up his voice.

Try it—and if you're afraid of scores, here's a fine chance to begin to explore one. Things move so slowly, there are so many convenient startings-again, that you'll have every chance, at leisure, to get adjusted to the look of music, as the musicians see it. You couldn't find a more apt way to get in a bit of real score study, on your own. Bruno Walter himself will keep you on the track, if you'll just keep the score opened and your mind on the alert.

The rehearsal itself? A model of clear, untemperamental discipline. You can *hear* what he talks about. Performance? I like it better than the Beecham above of the same, and oddly enough it has a more modern and more authentic small-orchestra sound than Beecham's, though Herr Walter is hardly out of Sir Thomas' own generation. (He's going on 80.) I'd quibble with many details, as will anybody who has enthusiasm and opinion, but that's what music is for. You will even find it instructive to study Sir Thomas in detail in the light of what Bruno Walter has had to say, at such length. I assure you they disagree most intelligently, in almost every measure! (See ABOUT MUSIC, page 72.)

Mozart: Abduction from the Seraglio (Die Entführung). Soloists, Chorus Cologne

I DREAMED I LED A HUNDRED MEN

There I was, reliving the exhilaration of the original recording. But now I had the opportunity to quiet the strings and bring up the blast of the kettle drum. With my new amplifier, the Munston Maestro, I felt I was not only listening to the orchestra — I was conducting it!

Yes, with the Munston Maestro you are there . . . and YOU are the conductor. Munston's "Dynamic B-T" makes it so!

You undoubtedly have had the experience of setting the equalizer control to the desired point—and then throwing the whole thing out of kilter by merely touching the bass or treble controls. You never knew whether you were adding or subtracting from the original recording settings.

Now with Munston's "Dynamic B-T" (Bass-Treble circuit), the correct settings for bass and treble are calibrated on the individual controls. You can set the bass and treble at exactly the same position as when the music was recorded. Then, if you do change either control, you are able to determine its relation to the original recording characteristics. And to please your own listening tastes, you can second-guess the recording engineer.

One look at the Munston Maestro and you'll have to agree that in a Munston you have the perfect exterior for any interior. Compact and streamlined, with a richly etched front panel, the Munston is truly music in motion.

Only **$79.50**

See the Munston Maestro at your local Hi-Fi dealer or write for complete information.

munston Maestro AMPLIFIER

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Famous the world over for its Marine Radio Telephone equipment.

MUNSTON MANUFACTURING, INC., Beech Street, Islip, L. I., N. Y.

Opera Otto Ackerman. With Ger.-Engl. libretto.

Mus. Masterpiece M113 (2 10") (OP 17)

The "OP 17" alternative designation here simply indicates the beginning of a significant bifurcation. Musical Masterpiece, a monster offshoot, mail-order-style, of Concert Hall Society, has now spawned not only Jazztone Society (and more millions of mail orders) but the Opera Society. This set evidently goes for both classical branches.

This organization, one of the most successful in the fabulous new wonderland of records-by-mail that is turning the industry inside out, seems to me to have excellent musical policies. The list of coming operas is most enterprising—the intention is to vary the standard works with others of as great or greater interest that, by happenstance, don't stand in the arbitrary opera house repertory of today. How unlike the craven attitude of other record clubs, that follow straight down the line with every standard work, opera or otherwise, with toadlike unoriginality!

Here, for instance, is one of the great operas of all Western music. No matter that you won't often hear it today in U. S. opera houses and opera broadcasts. So what. It has no less appeal to the wider general musical public because it doesn't fit into the ultra-narrow confines of our present stage-opera taste. This is no "grand" opera anyhow; it's a roaring farce, with the slapstick of an old-fashioned Jimmie Durante show and the exuberant preposterousness of the best in Gilbert and Sullivan, the whole encased in first-class Mozart music.

More than this—it's *German* Mozart, the text in the vernacular instead of the fancier Italian. Those who have sampled this sort of Mozart will know what is in store—this is not only comic opera but a popular one and intentionally so. The tunes are earthy, folkish, the satire is broad, the whole sound of the music is unbuttoned and offhand. Yes—Mozart could do it.

But enough. The Opera Society dares "risk" here what is sure-fire stuff. Once you get to know it—repertory-schmepertory, as the saying goes. The performance is highly adequate and therefore most enjoyable.

Adequate? That requires a further word. What I mean is, that though the soloists are hardly of first rank and some are pretty much so-so, the *performance itself*, the over-all conception, is excellent, right in style, lively, funny, intelligent, and musical.

We worry far too much in our own opera performances about individual solos—and we forget that an opera is a unity to be enjoyed as a whole. Our opera is notoriously at fault in these respects; too much solo, not enough team. For honest, personal enjoyment of opera the over-all style and shape and conception is *far more important* than the specific virtues of this or that voice! Here again, the Opera Society is on a right track, as far as mail-order home listeners are concerned. Only one voice here I really don't like very much, the soprano; but she is so well directed, her singing so thoroughly incorporated into the body of the performance, that very little harm is done. It could be vastly worse.

I was about to complain of a lack of libretto, but it turned up, complete in German and English, inside one of the pockets. With it you can know and hear precisely what is going on.

MORE BACH, HANDEL, ET AL.

Bach Organ Music, Vols IV, V, VI. Albert Schweitzer. **Columbia 5SL-223 (3)**

Columbia has lumped three LP's of the Schweitzer series into one album, with extensive notes in and out and around the various cardboard containers. The bulk of the music is in the Prelude and Fugue category, along with the Toccatas and Fugues, including the familiar D Minor in that last category and the C Minor Passacaglia and Fugue, of Stokowskiesque fame. Six of the chorale preludes are on one side of the set.

As evidence of the greatest living organist-mind, these Schweitzer interpretations are of very great interest, though in less fundamental respects they are stylistically of another time and do not bring through the music with the outward color and sharpness that we now expect. Schweitzer's musical background is as of the early 1900's. His famous —and invaluable—book on Bach dates from that time and, again, though it is full of the wisdom that can only come from a supremely great mind, it, too, is curiously out of date in many details. Schweitzer, as of around 1904, for example, doesn't think much of the harpsichord as an accompanying instrument and goes to considerable length explaining how the modern piano may be used to approximate Bach's intentions—he could not do otherwise than reflect his own time and it is hardly surprising that he did not then foresee the return of the harpsichord for use in its original role—aided enormously by the microphone. So it is with his own organ, modelled according to his ideas, as we hear it in these records.

The sound of his playing is, by modern standards of "Baroque" organ registration, relatively monotonous; the tone colors have a 19th century mellowness that is pleasing but not what we nowadays expect. Similarly, the performances themselves are in the older tradition, solid, unhurried, somewhat heavy, more plastic than brilliant, outwardly plodding but capable of an architectural building-up of tension that, as in the great C Minor Passacaglia, is unexpectedly overwhelming in impact. Schweitzer never was a virtuoso finger-and-foot man, but his breadth of mind—and his emotional understanding of the towering Bach structures—is not equaled by any other living Bach player.

That, needless to say, is the big value in these recordings. It can't be beat.

Bach: Four Suites for Orchestra. Philharmonia Orch., Klemperer. **With scores. Angel 3536B (2)**

Otto Klemperer has had his bad moments and for awhile seemed about to fly out of the musical picture entirely, but these and other new Klemperer performances show that he is still a sound musician and a power to

be reckoned with, conductorially. Moreover the frenetic high tension of his less fortunate recordings some years back seems to have abated. Klemperer is evidently a new man.

This, too, is an "old-fashioned" recording, in which a good deal of the once-popular symphonic approach is retained, but minus the exaggerations that we used to love so much in Stokowsky, the excessively slow tempi, the slowings-down, the romanticized sobbings and shoutings. All that is gone and what we have here is workmanlike, to the point and without eccentricity, a solid if old-fashioned performance of great musical value.

The recording is superb and not at all old-fashioned! Inner voices come through particularly well here—and this is no doubt Klemperer's idea as well as Angel's. So much the better, for this album has a beautiful set of miniature scores that are as useful and as easy to follow as the score in the Bruno Walter rehearsal, above. Bach's writing is concise, there aren't very many lines to follow, and many of the movements are very short with numerous repeats, so that you can't get too far off the visual track.

Bach Cantatas and Arias. Bach Aria Group, Wm. Scheide dir., with Robt. Shaw Chorale, Eileen Farrell, Jan Peerce.
RCA Victor LM 6023

This album from last season, must be cited as a prime example of too much solo, not enough team. The Aria Group, to begin with, made a practice of singing Bach arias removed from their context in the numerous story-telling Bach cantatas; their concerts were valuable but the fragmentation was extreme and Bach's original interests were served about as would be the case if a group of actors presented an evening of five-minute Shakespeare excerpts, each wholly unrelated to the next, as pure poetry.

In taking over this aggregation, RCA Victor has completed fragmentation by injecting, arbitrarily, its own "name" soloists (plus the Shaw name) in what would seem to be a sort of sales bid. Bach has little to do with it, I can assure you after a listening session with these performances, nor did he have any too much to do with the Aria Group's own balance of vocal performers, I would say.

The discreet orchestral group is excellent, if not vividly imaginative, but what we have for our listening in the vocal department is, most obviously to the ear, a haphazard collection of professional singers, each on his own and each with his own style, background, personality. I'm sorry to have to say that the famous Mr. Peerce makes an atrocious Bach singer. Miss Farrell is a fine musician but her forte is not Bach, for my ear. (Try her Wagner, which in spite of a shortness of breath in long phrases, is superbly done.) Others vary, good or bad, but there is no discernible ensemble.

As I say, too much solo, not enough team. I don't think RCA had any interest in a team to begin with, and I don't see why anybody in his right Bach-loving mind should go out of his way to put down money for this kind of recording venture.

Handel: The Messiah (Concert version). Soloists, Chorus, Handel Society, Netherlands Philharmonic Orch., Goehr.
Musical Masterpiece MMS 2019 (2)

Here, again from Musical Masterpiece, is the opposite, a really well-styled and consistently musical performance—in English—apparently put together from, of all things, an all-Dutch cast under a German conductor! Nevertheless, the English is faultless, the presentation in the well known and acceptable oratorio style without noticeable eccentricities or foreignness. The standard Mozart orchestration is used, with the usual largish chorus. One of the nicest "Messiahs" I've heard, in spite of what might seem insuperable "team" difficulties.

Recording is entirely listenable, though not exactly super-hi-fi.

Vivaldi: Il Cimento dell' armonia e dell' inventione, Op. 8 (including "The Four Seasons"). Reinhold Barchet, vl., Pro Musica Orch., Stuttgart, Reinhardt.

Vox DL 173 (3)

Another de luxe all-out album in the Vox series of complete editions. This Opus 8 of Vivaldi contains a dozen violin concertos, including the set of four now well known as "The Four Seasons." (The Opus 8 selection was arbitrary, a matter of publication convenience, and there is otherwise no more relationship here than would be true of any "representative" assembling of typical works of a composer for a "package" publication).

These German performances, like earlier ones in the same series, are well balanced, carefully correct, musical, keeping the contrast between solo and "tutti" always clear, warmly and resonantly recorded throughout. But with all of this, there is a certain lack of imagination and drama too. This is Italian music, after all, not German music.

But better these wisely conceived playings, I say, than the recent virtuoso offerings of several dynamic Italian chamber groups in which the very feeling of concerto, the opposition of solo and group playing, is obliterated.

There are detailed and somewhat laborious musicological notes (dozens of musical quotations) in a handsome booklet with nice illustrations. The background information is very interesting and readable, but the musical analyses are mostly superfluous for average listening. The ear can do a better job than all these words *about* the music.

FRANCE

Debussy: Le Martyre de Saint-Sebastien (Complete). Suzanne Danco, Nancy Waugh, Lise de Gontmollin; Union Chorale de la Tour-de-Peils, L'Orch. de la Suisse Romande, Ansermet.

London LL 1061

An outstandingly beautiful recording of a major late-Debussy work ordinarily heard in emasculated form, the instrumental parts only. Here the really lovely and powerful French-language solos and choruses make a vibrant new piece of what in the instrumental version seemed tired and dry.

The recording is technically extraordinary, too. Remarkable, almost eerie clarity of detail, the chorus full and alive, every word perfectly clear, the orchestra shimmering and colorful. A "hi-fi" record in the best sense, not a literal reproduction of a concert hall effect but a special sound unique to the recorded medium and one that is even kinder to Debussy than the live stage. A recording you should not miss.

Debussy: Preludes, Book 2. Gieseking.

Angel 35249

Debussy: Etudes; D'un Cahier d'Esquisses (1904). Gieseking. **Angel 35250**

Two more issues in one of the finest piano series now being released, played by that living exception-that-proves-the-rule, the German pianist who plays better Debussy than (almost) anybody else alive. Whether he's tops or no—a matter of futile argument—this Debussy by Gieseking is extraordinary. No other pianist I've heard has made such immediate sense of these ultra-French and unique piano works except, perhaps, George Copeland—an American. Gieseking is simply worlds ahead of competition, among the Casadesus, Arraus, Henkelmans, though these and others have their excellent values pianistically. He is a wizard; one can ask—is he a musician? is this music? is it some special kind of hypnotic sound? It doesn't matter too much, as you listen to the fascinating stuff.

The recording continues rather distant and broad in sound, unpercussive. Some don't like it but it still suits me to a T—and Debussy too.

Gounod: Mireille (complete opera). Festival d'Aix-en-Province, 1954. With libretto. **Angel 3533C (3)**

Here is a major opera by Gounod, of "Faust" fame, that is mostly unknown to Americans though the French seem to have been familiar enough with it all these years. This is a recorded version of a notable festival performance given in the strange and romantic cave-town of Les Baux, France, where aluminum ore (Bauxite) was first mined. I visited the place as a kid in 1927 and remember its wild scenery very well and can imagine that an outdoor opera there, amongst the strange caverns and the mountains-of-the-moon, would be memorable, indeed.

I've only sampled this; you'll find a lot of the memorable sort of Gounod corn, à la Faust, sweet juicy melodies, lovely sentimental accompaniments, much fine heroic passion, the whole rendered into something fine, as always happens when French music is sung by an all-French cast. For the truth is that Gounod, and other romantic French composers, are properly heard only in French performances—there is a world of difference!

I won't soon forget my first "Faust" at a New York opera performance, complete with most of the night before's "Meistersinger" scenery and costumes, like leftover scrambled eggs. Nor will I forget, in contrast, a French recorded performance of the very same music, suddenly moving, musical, and dignified. That's what happens here—if you can stick out a pretty long slice of opera—three LP records.

A huge illustrated booklet, with articles, pictures, libretto, gives you the background.

Chausson: Concert en Re Majeur pour Piano, Violon et Quatuor à Cordes, Op 21. Francescotti, Casadesus, Guilet Quartet. **Columbia ML 4998**

Well—that's what this music is called in French, anyhow. It's a sort of semi-concerto,

for violin, piano, and string quartet. Chausson (wasn't he the composer who died prematurely when he fell off a bicycle?) was a pupil-follower of César Franck, without that man's gentleness and humility; Chausson uses similar musical language but he is more dogmatic and insistent, more elaborately concerned with his own special theories of composition. Since those theories are both out of date and irrelevant now, what is left, alas, is mostly the dogmatism, which comes through only too clearly. Chausson, here, is wordy, long-winded and pretentious and the nice melodies and harmonies aren't enough, for my ear, to neutralize the unpleasantness.

Maybe a gentler team of performers might find a more spiritual and expressive way to treat the music. I doubt it, but it might be possible. (But Chausson did write one lovely and gentle piece, the well known "Poème" for violin and orchestra. His "Poems of Love and the Sea" is a pleasing work, too, for soprano and orchestra, and the Gladys Swarthout version on RCA Victor is good.)

Franck: Psyché (complete). Hague Philharmonic, Netherlands Chamber Choir, Van Otterloo. **Epic LC 3146**

Here's Franck himself, and the orchestral parts of this symphonic poem will have been heard and enjoyed by many readers already. But how many of us knew there was also a vast stretch in "Psyché" for chorus and orchestra—almost as much again as we ordinarily hear in the instrumental suite? Here it is.

The choral parts are very French, very Franck, as melodic and romantic as you could wish, with long, flowing lines, the always-appealing Franck honesty and directness. But, it'll have to be admitted, there's an awful lot of it and the bigger climaxes wax rhetorical to an almost Wagnerian degree.

Nice recording; the French words are mostly inaudible (printed text helps), perhaps due more to the Dutch singers than the Epic mikes.

Sidney Bechet: La Nuit est une Sorcière (ballet). Symphony Orch., Jacques Bazire; S. Bechet, clarinet.
London-Intern. WV 91050 (10")

This is what happens when a top jazz musician is persuaded to go "classical" in a big way, an ultra-serious tragic ballet with a plot which—even allowing for the fact that most ballet plots look silly in plain words—is the zaniest nightmare I've read about yet. Boy somnambulist, white (Georgia), wanders asleep in favorite haunt, a hayloft; kills all his relatives, plus fiancee, one by one, when they try to wake him; then boy's negro valet, fanatically attached, leads him (still asleep) to certain death out the barn window, or something. Gory!

The music is made up of heavily portentous bits of repetitive jazz (Bechet playing), larded out with the flimsiest of dinner music, TV-tragedy platitudes for orchestra. Nevertheless, when Sidney Bechet's mike-magnified clarinet comes in—you know it's somebody big. Even in this dreary setting. Fabulous big-sound hi-fi recording.

SPECIALTIES OF THE HOUSE

Grofé: Hudson River Suite. André Kostelanetz & his orchestra. **Columbia CL 763**

Ferde Grofé is one of the Deans of American music, as the phrase goes; he's been at it since Gershwin and the "Grand Canyon." Grofé is the dean of those musicians who are, typically in the U. S., arrangers by genius, composers by imitation. Grofé is an orchestral wizard and always was—but he, like many another, has never been able to write what is euphemistically called an original note of music. It's all neatly and beautifully borrowed.

Why be original? No necessity at all—if your borrowed material, like Mozart's, builds into rock-solid structures with their own logic.

"Hudson River" is a good piece. It is wholly honest, makes not the slightest pretence at being other than it is, one of those entertaining, scintillating, utterly harmless orchestral pops pieces. It's much less pretentious than

(*Continued on page 68*)

NEW PRODUCTS

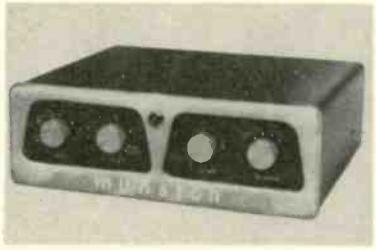
• Ampex Stereophonic Tape Phonograph. Professional standards prevail throughout in the new Ampex Model 612 phonograph. Designed to play full-track, half-track, or two-track tapes for stacked heads, the 612 may be used with existing high-fidelity systems or in conjunction with Model 620 power amplifier-speaker units built by Ampex. Playing speed is 7.5 ips. Frequency response is 40 to 15,000 cps. Flutter and wow are less than 0.25 per cent. Two amplifiers are incorporated in the 612, one for each track. Power amplification must be provided externally as a part of the music system with which the reproducer is used. Both the tape phonograph and the 620 power amplifier-speaker

units are available in handsome furniture-styled cabinets for home installation, or in Samsonite carrying cases for portable use. The 612 measures 9" x 15" x 17½". Descriptive sheet will be mailed free on request by Ampex Corporation, 934 Charter St., Redwood City, Calif. **V-9**

• Stephens Super Tweeter. Recently added to the line of high-quality speakers manufactured by Stephens Manufacturing Company, 8538 Warner Drive, Culver City, Calif., is the Model 212 Super Tweeter. Although the 212 has heretofore been incorporated in the Tru-Sonic 152AX

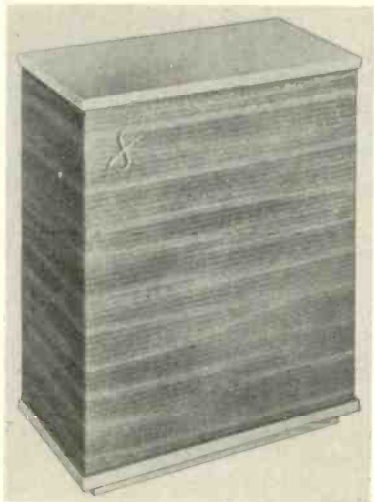
and 122AX coaxial speakers, until now it has not been available as a separate item. The unit features an exclusive Stephens double exponential horn to assure wide, even dispersion. It incorporates a hand-spun aluminum diaphragm activated by a fully-enclosed magnetic structure. Frequency response extends from 5000 to 18,000 cps. **V-10**

• Munston 10-Watt Amplifier. Continuously-variable equalization and calibrated tone controls are among the features incorporated in the Munston Maestro, a compact new amplifier recently introduced



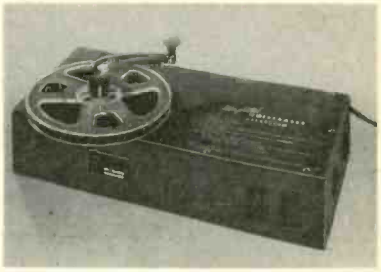
by Munston Manufacturing Co., Beech Street, Islip, N. Y. Notwithstanding its small size of 3⅞ x 9 5/16 x 8 3/16 ins., the Maestro delivers a full 10-watt output with less than 0.5 per cent harmonic distortion. Frequency response is within + 0.5 per cent from 20 to 20,000 cps and noise level is 55 db below rated output. Excellence of performance is matched by Maestro's stunning appearance, the control panel being recessed to produce an attractive three-dimensional effect with black and gold decor. **V-11**

• Three-Way Speaker System. Exceptionally low distortion is inherent in the new "Forester" 3-way speaker systems recently introduced by Sherwood Electronic Laboratories, Inc., 2802 Cullom Ave., Chicago 18, Ill. Based on the principle of



complete acoustical and electrical isolation of each of three specially-designed speakers which cover the entire audio range, the Forester is stated to have only 0.6 per cent intermodulation distortion at 10 watts. The individual speakers are 12-, 8-, and 5-in. units with 300- and 5000-cps crossovers. Various cabinet styles are offered in a wide variety of finishes. Speakers and crossover networks may be purchased without cabinets in "do-it-yourself" kits. **V-12**

• Magnetic Tape Eraser. Because of its ability to remove all program material from an entire reel of magnetic recording tape in a matter of seconds, the MEC Magnetic Noiseraser should receive ready acceptance as standard equipment for broadcast stations, recording studios, and laboratories which use tape for preservation of technical data. The device elimi-



nates all signal and background noise from recorded tape, and may also be used for conditioning new tape when required. Operation of the Noiseraser is extremely simple. The spool to be erased is placed on a spindle, a switch controlling the magnetic circuit is turned on, and the spool is rotated manually through slightly more than one revolution. The entire process requires about 15 seconds. The unit is manufactured by Minnesota Electronics Corporation, Burbank, Calif. **V-13**

• Popular-Priced Magnecorder. Newest addition to the Magnecord line of tape recorders is the "Citation," a popular-priced model designed essentially for home, school and business use. A two-speed re-

corder, the "Citation" has a frequency range of 50 to over 10,000 cps at 7.5 ips, and 50 to over 5000 cps at 3.75 ips. A built-in VU meter permits precision of recording level. The "Citation" is handsomely-styled in a brown leather case, with control panel finished in ivory and satin gold. Complete details are available from Magnecord Inc., 1101 S. Kilbourn Ave., Chicago 24, Ill. **V-14**

• Vacuum-Tube Audio Level Meter. Unlike conventional VU meters, the Model 5514 Kilpatrick Vacuum-tube Audio Level Meter may be used in any portion of the circuit of any audio system, from preamplifier to speaker or recording head. The input impedance is 1 megohm and reference level is adjustable from 0.7 to 350 volts peak. Feedback stabilization makes the indication independent of line and

tube fluctuations. The unit may be used up to several hundred feet from the signal source. For application notes and prices, write Kilpatrick Electronic Laboratory, Box 61, Norristown, Pa. **V-15**

HARVEY the House of Audio

The NEW

REK-O-KUT *Rondine*

3-Speed, 12-inch

PRECISION TURNTABLES

Represented to be the result of more than 5 years study, these new record playback units are offered as the closest approach to perfection in turntable performance. Like all Rek-O-Kut units, the turntable is cast Aluminum and exerts no pull on magnetic cartridges.

The following new features have been included: • single selector knob for setting speed: 33⅓, 45 and 78 rpm. • built-in retractable hub for 45 rpm records—requires no external adapter • permanently affixed 3-speed strobe discs for instantaneous speed checking • neon pilot light as 'on/off' indicator • special cork-neoprene mat material to eliminate record slippage • rectangular deck to fit conventional record changer boards.

Two identical Rondine models are available which differ only in the type of motor employed.

Rondine Deluxe Model B-12H hysteresis synchronous motor **$119.95**

Rondine Model B-12 with 4-pole induction motor 74.95

Printed-Circuit Miniaturized **"Preamp with Presence"**

—as described by C. G. McProud in May Audio Engineering.

Basic kit containing the 1.0 henry encapsulated choke, the printed circuit panel completely drilled, and the four metal chassis parts **$7.50**

The complete kit of parts, including the basic kit and all other parts and tubes as specified by author. With complete, simplified instructions **$35.50**

REL *Precedent*

FM TUNER

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

Chassis only (for custom installations) **$325.00**

Relay Rack Model 335.00

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FAIRCHILD

Series 220

Diamond Cartridge

Employs moving coil principle and provides smooth response from 20 to 17,000 cycles ±2db. Low mass and high compliance give exceptionally good tracking, low needle talk, minimum record wear and virtually no distortion. Operates into magnetic cartridge inputs provided in conventional preamps. Available as follows: **Model 220A** — 1.0 mil for microgrooves. **Model 220B** — 2.5 mil for transcriptions.

Model 220C — 3.0 mil for 78 rpm.

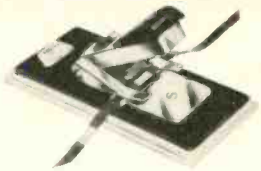
Series 220 Diamond Cartridge (specify model) **$37.50**

FAIRCHILD Transcription Arm — Series 280

Accepts all variable reluctance and dynamic cartridges, and permits interchange without screwdriver or other tools. Built-in muting switch eliminates hum when interchanging cartridges. Provides perfect midgroove tracking with no side thrust or groove jumping. Has adjustments for height and level. Requires no arm rest. Two models available:

Series 281A for 16" transcriptions **$35.95**

Series 280A for more compact installations 33.95



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Cutter-Splicer

Model TS-4

Makes splice in "Gibson Girl" shape, leaving edges of tape entirely free of adhesive and ending erratic operation, wow, and flutter caused by adhesive deposited on critical parts of recorder. May be removed from base and mounted directly on recorder.

Model TS-4 ..... **$6.79**

AMPEX 600

PORTABLE TAPE RECORDER

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

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

Other features include:

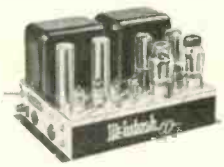
•Signal-to-noise ratio: more than 55 db • Flutter and wow: less than .25% • Fast forward and rewind: 90 seconds for 1200 feet • Microphone input: high impedance • Line input: for high level source (.5 volt level) • Separate level and mixing controls for microphone and line inputs • Monitoring: through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

Complete with tubes, less microphone **$545.00**

AMPEX 620

PORTABLE AMPLIFIER-SPEAKER SYSTEM

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



The NEW

Mc INTOSH

Model MC-60

60 WATT AMPLIFIER

Employing the famous McIntosh-exclusive circuit with unity coupling, the new Model MC-60 provides performance within .4% of theoretical perfection. The tremendous reserve power made available by its 60 watt output, gives the MC-60 a distinct advantage in handling transients and other sudden surges without overloading or distortion and contributes immeasurably to the realism of reproduction.

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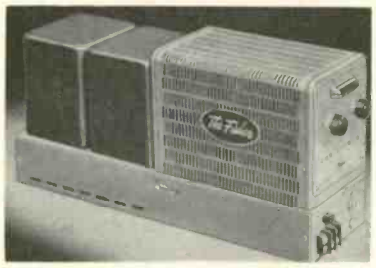
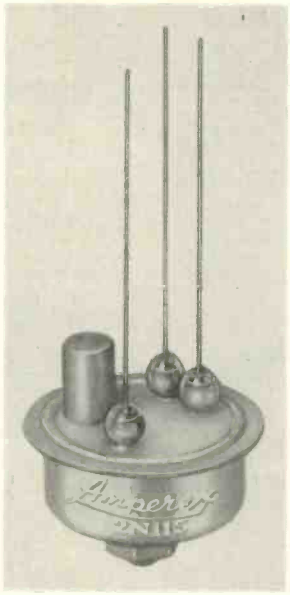
● **Fisher 30-Watt Amplifier.** PowerScope, a peak power indicator calibrated in watts to show instantly the peak load on the speaker system, is among the unique features incorporated in the new Fisher Model 80-AZ amplifier. Also included in the unit is the Fisher Z-Matic circuitry for constant amplifier-speaker impedance match. Frequency response is within 0.1 db from 20 to 20,000 cps, while power output is constant within 1 db at 30 watts from 15 to 35,000 cps. Harmonic distortion is under 0.5 per cent at full rated output, and intermodulation is less than 0.5 per cent at 25 watts. Three separate feedback loops afford minimum distortion and superior transient characteristics. Three controls are provided, one each for PowerScope, Z-Matic, and input level. Manufactured by Fisher Radio Corporation, 21–21 44th Drive, Long Island City 1, N. Y. **V-16**



● **Power Transistor.** In response to the prevailing need for a transistor with greater power handling capacity than those heretofore available, Amperex Electronic Corporation, 230 Duffy Ave., Hicksville, N. Y. has introduced the Type 2N115 P-N-P junction power transistor which delivers 5 watts push-pull output with a 6-volt supply. Relationship between base current and collector current is extremely linear, and gain is exceptionally high for the power level. The transistor is internally insulated from its metal case, so that no external insulation is needed when mounting the unit on a chassis. Output impedance is so low that a 5-ohm speaker voice coil may be connected directly as the collector load in an audio output stage, thus removing the need for an output transformer. Among the more evident functions for the 2N115 is its use as the output stage in automobile radios. Complete data will be mailed on request. **V-17**



● **Electro-Voice Do-It-Yourself Kits.** A complete line of do-it-yourself kits which make it easy for hi-fi enthusiasts to build their own acoustically-correct Electro-Voice speaker enclosures at savings up to one-half, has just been introduced by Electro-Voice, Inc., Buchanan, Mich. Every piece in each kit is pre-cut and ready for easy assembly. Exterior surfaces are clear-grained birch. There are seven models to choose from, including the E-V Patrician and Georgian interior "K" horn units, the complete Baronet,

Aristocrat and Regency, and the new Empire and Centurion enclosures. A wide choice of finishes is easily obtained by using an E-V finishing kit, available separately. An illustrated do-it-yourself book is included with each E-V kit. For complete information, write for Bulletin No. 211. **V-18**

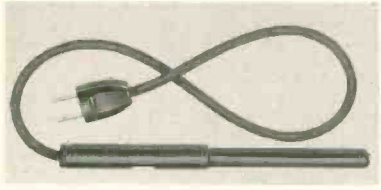
● **Low-Priced Amplifier Kit.** For the budget-minded user, the new Magna Amplifier Kit incorporates the latest features in circuit design and the finest in nationally-known component parts. Frequency range of the amplifier is stated to be 20 to 100,000 cps within ± 1 db, with distortion less than 1 per cent at full 10-watt output. A specially designed output transformer uses a high-quality Silicon steel core. The unit has a built-in preamplifier for handling low-level signal sources, such as microphones and magnetic cartridges, and

is equipped with loudness, bass, and treble controls. Output impedances are 4, 8, and 16 ohms. The kit is supplied complete with all necessary parts for simplified assembly excepting wire and solder. Step-by-step instructions and large pictorial diagrams enable the builder to assemble the amplifier without any previous experience in electronics. A fully-illustrated catalog of the entire line of Magna electronic kits will be mailed free upon request to The A & M Company, 616 S. Serrano Ave., Los Angeles 5, Calif. **V-19**

● **Gray Turntable-Tone Arm Combination.** This newly-introduced product of Gray is designed with extreme rigidity to assure elimination of rumble and noise. An exceptionally long tapered center bearing removes the possibility of turntable sway. The motor shaft engages the Neoprene table rim directly, without any intermediate idlers. The table is surfaced with cork-impregnated Neoprene to eliminate record slippage. A three-speed player, it is available with either an induction-type or hysteresis motor. Unusual among unusual features is a cue light in the arm rest which provides sufficient illumination for

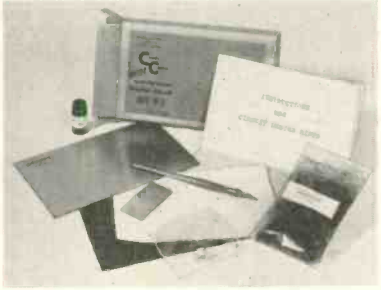
placing the tone arm on record in a dimly-lighted room. The turntable assembly is available with or without the well-known Gray Model 108C viscous-damped tone arm. The entire unit is completely shock-mounted. Manufactured by Gray Research and Development Company, Hilliard St., Manchester, Conn. **V-20**

● **Tape Erasing Pencil.** Developed for use as an accessory in film or tape recording, the new Type 8905 Magnetic Erasing Pencil is ideally suited for erasing limited areas when it becomes necessary to remove a short word or even a single syllable. The unit operates on 115 volts a.c.



and consumes 10 watts. It is supplied complete with press-to-operate switch and six feet of cord. Dimensions are similar to those of a king-size fountain pen and finish is in black phenolic. Cinema Engineering Company Division, Aerovox Corporation, Burburbank, Calif. **V-21**

● **Printed Circuit Kit.** A do-it-yourself printed-circuit kit for experimental and development engineers has recently been placed on the market by Control Circuits, Inc., 24 Broad St., Middletown, Conn. The kit enables the development engineer to evaluate his printed circuit designs before



passing them along to a production department. Designed by engineers who use identical kits in their own work, the package contains a sheet of copper-clad laminate measuring 8½ × 5 ins. and all other materinls required to make etched or printed circuits. Also included is a helpful booklet of instructions. **V-22**

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the 3rd audio anthology

AUDIO ETC.

Edward Tatnall Canby

1. De-rumble-izer

BY SEMI-HAPPENSTANCE I've had a peculiarly apt combination of components "under observation" and use during the last few months. One I've already mentioned, the big-bass, small-size speaker with the un-apt name of AR-1, Acoustic Research being the maker, which produces the lowest bass I've ever managed to get inside a fairly small room. Another —which proved to be neatly complementary and antidotal, is a high class amplifier in the same general quality bracket as the AR-1 speaker, the H. H. Scott 210-C, current model of the original Scott Noise Suppressor Amplifier launched some years back, before the LP record had been heard of, to cope with the hiss and scratch of the 78 rpm record as reproduced through high-quality widened-range equipment.

Apt is the word! AR-1, potent in the lower regions, reproduces every bit of rumble and bumble that may happen to be available, as does every quality low bass system. The Scott amplifier takes it out again, most ingeniously. It has a dynamic rumble filter.

But of course, the 210-C has much more than this, as befits a fairly expensive one-piece unit designed to cope with today's home reproduction from A to Z. It has all the things you might expect, from equalization to several tape outlets, inputs for radio, TV and tape, loudness compensation, level-set for the phono input, standard tone controls (well-curved ones, too), and so on. But to my knowledge there is no other amplifier on the market with the type of rumble control available in this model and, moreover, I have found it wonderfully useful in many situations. And so I point out this special feature for your information as of particular interest.

The rumble feature is actually a part of the Scott "Dynaural" (dynamic) noise suppressor in its latest form. The original models of this control stressed the suppression of record hiss and scratch in the high end, though control of the bass was included too, as I remember, even in the earliest models. But the appearance of the plastic record and the consequent lowering of surface noise naturally reduced the usefulness of the high-end suppressor circuit —though not by any means removing its utility altogether. At the same time, the increasing emphasis on good bass response in home systems, extending right down to the lowest-priced speaker cabinets, made the problem of extraneous bass noise more serious as that of extraneous high-end sound became less important. A shift from high to low.

The Noise Suppressor has shifted too. Mr. Scott still provides a perfected and foolproof combination of cut-off and dynamic suppression in his new models, making faulty operation of the suppressor circuits unlikely even by the dimmest dimwit. (There was trouble at the beginning with controls that were so flexible that most users didn't find out how to match the suppressor's action to the level of the music. It suppressed too hard—or not hard enough.) The high-end cut-off provides several top limits, 20,000 cps, 12,000, 6,000—no lower—in the conventional manner: the suppressor circuit cuts this down lower, according to the dynamics of the music, opening up for the loud parts, closing down for the soft parts where the background noises come through, the opening and closing controlled electronically by the signal itself. That, of course, is the principle of "dynaural" or dynamic suppression as opposed to "static" or fixed noise filtering.

A separate control, continuously variable, combines all the suppressor circuit controls so that all you need to do to adjust the suppressor to the music-of-the-moment by ear is to rotate it until things sound right. The simultaneous adjustments combined in this one operation are Mr. Scott's neatest contribution to his own original idea, as far as making it really practical for home use.

The rumble filter, as I get it, is simply a suppressor position (on the selection switch, alternative to the cut-off positions) which applies dynamic suppression to the bass but leaves the highs alone. The dynamic principle is the same. The bass, I gather, opens downward at higher (bass) volumes in the music but closes upward when less bass is present in the signal, to remove the rumble that would otherwise be audible. When there is loud bass music, of course, the rumble is hidden; hence the bass is allowed to come through.

The further you turn the "dynaural" knob, the more drastic is the effect upon the bass. At its minimum position there is still a noticeable difference between the "off" and the "rumble filter" positions—but as you turn the knob the removal of background rumble and throb increases. The maximum position leaves you with almost complete silence in the lower regions, a more complete bass removal than I remember hearing for a long time in a regular amplifier control. But at this position the musical bass—if any—is also pretty much removed even in the loudest passages. You pick you own degree of dynamic filtering to suit your ear and the situation-of-the-moment, *ad lib.*

Now don't think this gadget is merely for severe rumbles from obsolete turntables and the like. With a genuine, low-bass speaker system even the finest tables and/or the finest records bring through a certain amount of low-pitched noise, sometimes so low that it simply shakes the room without

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

producing much pitch. A rather unpleasant discovery, this, when you try your first really low bass reproducer. At a fair distance—in another room, around a corner, at the far side of your listening area—you may not be disturbed by it. Rumble doesn't carry far. But at close range it can be most annoying. And especially in music that allows it to come through—music, paradoxically, that does not have much bass, or musical passages where the bass is temporarily missing, or passages at a low level (as in many slow movements), where the music, even with bass included, may not be loud enough to disguise the rumble.

And so the H. H. Scott rumble filter, adding the advantage of dynamic operation—letting through maximum musical bass where it exists—is rapidly becoming most important in my listening equipment, now that I'm definitely in the big-bass area. Indeed, I've been using it for all sorts of recorded music. For instance—

1. Most orchestral music is benefited, except that which has unusually loud and low bass without much recorded rumble. In a few such cases I prefer to hear the whole bass range. But in most records the dynamic principle opens the electronic bass "gates" wide enough to let through all I need; and in-between, the reduced rumble is a musical asset that adds realism.

2. Many kinds of music without bass are very greatly benefited. *What—no bass?* Certainly. How about a guitar, or guitar-folk-singer combo? (Remember that the male voice isn't very low, either.) What of a Bach sonata for violin unaccompanied—or the same by Bartok? Those two types were vastly improved when the maximum bass removal on the Scott was used. Velvety silence in the background, and *all* the music reproduced, to perfection.

3. Recordings of the spoken word are greatly improved when the bass rumble departs. There is no low bass at all in this type of recorded sound, unless in musical interludes and backgrounds. Recorded poetry and drama are particularly aided. You have no idea how much more satisfactory such records are in the playing when the maximum bass removal is used.

Piano recordings respond especially well to the Scott rumble filtration. I assume that the sudden percussive peaks of piano tone open up the dynamic controls quickly and widely to let full bass through even when the control is set to remove a large part of the low-range rumble and hum. Orchestral bass is less sudden and less sure in its action.

Paradoxically, records that are thin in the bass can be boosted via the regular bass tone control—then the low-bottom rumble can be cut out with the dynamic filter. Without the filter the boosted rumble would be too much to bear. I tried this with marked success on a reissue piano record where the bass was over-attenuated. I got improved bass fullness without added rumble. Good for many older piano recordings that were made with thinnish bass.

* * *

I'll only add a couple of comments to this elegy on bass removal à la Scott. First, the treble-end suppressor circuit is still available in the Scott 210-C (and elsewhere in the line). It is still moderately useful in removing the residual scratch and hiss in some LP records (though it can't do much for loud clicks and pops) but its greatest value is for old shellac 78's. Plenty of them still exist and are treasured, and, now that we have lost our once-expert ability to ignore their recorded scratch, a gadget that gives us maximum music and minimum hiss is more useful than ever.

Note that the traditional aural difficulty

with the Scott suppressor at the high end, the sometimes too-noticeable change ("swish") in tonal quality as the highs are variably let through or cut down, dynamically, does not occur at the low end. Our ears are relatively insensitive to the changes in low-frequency response and the operation of the low-end suppressor circuit is very rarely noticeable, in action. That will recommend it to many of us who never could quite get used to the high-end dynamic action, no matter how nicely adjusted and controlled.

2. Collaro and Pirouette

I've been using two tables, alternatively, in the two classic forms of today's hi-fi, the changer and the non-changing turntable. The Collaro changer, English-made, is a reasonably priced machine competing with the standard American brands and it seems to have made a lot of friends hereabouts since it was introduced a few years back. The current model, RC-54, does all the things a modern changer is supposed to do and it has been operating quite uneventfully and well for me since I got it into action—the best recommendation I can give it. Even Hurricanes Connie and Diane didn't stop it last summer, though after Diane drenched us it did act a bit dazed until the moisture dried out, turned itself off a couple of times and got its signals slightly mixed. Any respectable changer would have done the same, and RC-54 was back to normal as soon as the weather settled down.

Things I like about the Collaro: (A) Its changer action is constant-speed—always the same rapid change regardless of the turntable speed.

(B) Here's one changer that retracts its drive wheels automatically when it turns itself off. I didn't believe it at first, but it's true.

Minor questionings: (A) An oddity on the Collaro is a bit annoying—a sudden double pop from the mechanism as it adjusts itself. Perhaps this noise will be engineered out, anon. (B) My Collaro came in a factory box and I found that not only was it unmounted, but it had not even a power cord attached, nor for that matter any indication as to where the same was to be soldered. Nor was any pickup cable in evidence. I had to make up both and prod around the insides until I figured out where they should go, among numerous contact points.

Moral: If you buy a changer in bulk, so to speak, be sure to check on its state of readiness and, if you are unapt at making soldered connections (and if you have no loose shielded cable and plug-in tips on hand) hobnob with your dealer until he fixes it up for you. Equipment in factory cartons usually has power cords and signal cables ready-attached—but not always.

SPECIAL NOTE

Edgard Varése's "Deserts," for precussion orchestra and two recorded tape tracks will be performed in Town Hall, New York (113 West 43rd Street) on Wednesday, November 30. This is the work discussed in detail by Edward Tatnall Canby in the July issue (page 28) as performed last spring in Bennington, Vermont. Mr. Canby will assist M. Varése in the preparation of the New York performance, which will make use of two separate tape 15 ips players in place of the single two-track machine used at Bennington. Tickets are on sale at the Town Hall box office.

The "Pirouette" turntable from Presto enters the field and continues the trend towards quality turntables designed primarily for home hi-fi use.

I like the big 3-speed and on-off switch—more of a handle than a switch—which has 33 as the center position with 45 to one side and 78 to the other and neutral positions in between. It is both mechanical and electrical, a development of the type that the Rek-O-Kuts used but without the screw-down knob; this knob slips into place via detents and microswitches. The drive is semi-direct—i.e. only one rubber wheel between motor and rim for each speed; wear on the rubber will not affect the speed. Three smallish wheels are mounted on one moveable plate.

It wasn't Diane that bothered my Pirou-

ette. It was simply a lack of oil. Mine had been run at an Audio Fair for X million hours before I got it; I simply put it to work and waited to see what would happen, as usual. No oiling. Eventually it developed a slight waver. What did I do? Played it some more, natch. Just what any dope would do, like the guy whose car begins to knock and wheeze—he just keeps right on driving.

When the waver began to turn pianos into guitars I took a look under the turntable, at last. (A simple thing to do, but, I ask you, how many home owners would dare? The gadgeteers—yes. But not Mesdames and Messieurs the Greater Public!) But there wasn't anything wrong that a bit of oil wouldn't fix—so I squirted about two tablespoonfuls, in typical home manner, all over the insides. (Neoprene rubber wheels, unaffected by oil.) The waver departed immediately.

But who said a turntable was supposed to run without lubrication? Especially after an Audio Fair. Since I lubricated it, my Pirouette has behaved nicely and one other very minor trouble has disappeared too; at first the shift lever was so stiff that sometimes the stylus jumped a groove when I shifted from neutral into 33. Now it shifts almost as smooth as butter.

3. Control Units—GE and Fisher

The biggest trouble with my assorted systems-of-the-moment is likely to be redundancy.

For instance, I was well provided with every sort of control—and input, output, bypass and what have you—by the previously mentioned Scott 210-C, but in addition I had on hand two separate control units that I wanted to try out. At one point, just for kicks, I had them all hooked up in tandem. Compensate three times in a row for the RIAA curve and you come out with a very odd sound. Actually, this isn't such a laughing matter. It is very easy for most of us inadvertently to duplicate functions in that fashion when an extra control unit is hooked up to existing facilities. This is a first warning to heed in all such situations. The best engineers can do it.

GE introduced a simple control box last year, tubeless and non-amplifying, the GE Record Filter, A1-901 that does an excellent and surprisingly thorough job in its proper place, between a GE cartridge and the input to a preamplifier. It provides equalization curves for the main types of recording now in use on one knob. Two other knobs give you several positions each of bass and treble cut-off—making use of the cartridge itself as part of the filtering circuit. The whole is enclosed in a neat brown plastic box.

The use of the cartridge as a part of the circuit is an excellent economy and was so intended by GE. But this accounts for the fact, perhaps not too plainly stated, that this control unit is for use *only* with the GE cartridge, any regular model. (Will not work with the GE chrome-plate professional models, but these are rare in home installations.) If you hook it up to a different cartridge you'll get equalization and all the rest—but the curves will be utterly zany. Unless your other cartridge just happens to be identical with the GE itself, a circumstance that would seem to be rather unlikely.

The unit, duly hooked in with a GE, worked fine for me and the curves seemed to be equivalent, by ear, to those available on the much more expensive Scott amplifier—they should be, of course, so the little box did what it was supposed to do. Only one thing bothered me and is likely to con-

fuse others than me, I suspect. What about bass equalization?

If, for instance, you use this unit with one of the old GE separate preamplifiers, you'll have your bass equalization already present in the older unit, the preamplifier. The new gadget takes care of the high end, variably, according to the *upper half* of the accepted curves now in use—RIAA, NARTB et al. Good. But keep in mind that this tubeless control does not amplify and does not therefore compensate records in the bass end. That must be done by the preamplifier into which it is fed, and these days, it isn't always easy to figure out what else that preamplifier may be doing, too.

Thus in order to hitch the GE unit to the Scott amplifier I used a position on the Scott phono equalization switch marked SPEC. That one, if I am right (I *always* leave the instruction booklet somewhere out of reach) provides bass compensation for LP records, but leaves the highs flat, untouched, as in the old GE preamplifier. (We used to use a fixed loading resistor to bring the highs down to an average roll-off that roughly matched most records.)

So—if you follow me—the new GE control was being used as intended; it provided the high equalization, plus the bass and treble cut-off; Scott provided the bass compensation. No duplication.

Well . . . put it simply, this way. For those who have older amplifiers or phonographs without the fixed (RIAA etc.) curves indicated on them, or who have controls that don't seem to be sufficient, this GE unit adds definite new flexibility at minimum expense. But be sure you have a GE cartridge *and* a preamplifier that already takes care of the recorded bass (they all do except microphone preamplifiers) but *not* the highs—or has a "flat" position in the high end. A large number of existing systems have exactly this and can directly benefit from GE's control unit. Most of them, I suspect, are simple phonographs, or revamped phonographs, that now use the GE cartridge with preamplifier, yet have inadequate controls.

* * *

A control unit of a startlingly different sort is the new Fisher 80-C Master Audio Control, which has everything at a very reasonable price for top-quality hi-fi equipment. This one is a preamplifier with tubes, and with multiple inputs, outputs, recording curves. It has five channels on the front panel, each with push-button and volume control and there are no less than nine plug-in receptacles (plus two extra power outlets) on the back.

In other words, this is one of those "all-out" control units with every possible feature that the designer could think of built into the most compact and good-looking arrangement he can figure out. We've had a number of units in this category before—Marantz, H. H. Scott, McIntosh, Brociner, Bogen, EV—and, indeed, most manufacturers in the field have offered them. When a profusion of control functions is thus to be offered, it's inevitable that each designer or maker shows his own personality and preferences in the choice, arrangement, and even in the all-important labelling of control functions. This is as it should be and gives an individuality to each of these complex units that allows for the greatest choice on our part, according to *our* personality and taste.

Thus I got hold of the Fisher 80-C, deliberately, because it looked to me as though it would match *my* personality and taste in control functions. An arbitrary matter, I admit, and I hasten to recommend that other units in the field be studied up too by those who may have different needs. This is one area where we still have a bewildering and gratifying diversity of hi-fi thought.

The 80-C has several aspects worth pointing out aside from its good looks and excellent panel arrangement, about the easiest to read and operate I've ever seen. First, the specs on performance are breathtaking, the over-all quality of its electrical operation is pretty closely comparable to that of a professional broadcast console control board. Other competing units no doubt are now as good or will be—I point out merely that this is the current standard for really hi-fi operation of controls in the home. Super. All the factors of hum, distortion *et al* so low as to be inaudible and mostly unmeasurable in the lab. And all this, mind you, in the middle price range, by no means at the top. So it goes in audio these days.

Second, the 80-C has five separate input channels each with its own level-set or volume control and these are all mounted on the front panel, for mixing ad lib. Each one has a green light and each has a push-button. You can mix all five electrically if you want some real cacophony. Better—you can mix any two or three, for more practical usage: radio and your speaking voice, tape input and phono input, and so on. This would be impossible without the volume-control-level-set feature.

I tried hard to figure a way to mix five channels at once, but the mere thought of it was just too much for me. However, I did try various combinations, and the results were as expected—excellent. My only reservation is mechanical; the electrical circuits are willin' but the push-buttons aren't. I haven't figured a way yet to push in all five buttons at once—they pop out again as fast as you push 'em in. Two is easy, however, and three is easy if you have both your thumbs available. I'd suggest that future 81-C's or 80-D's use a more amenable kind of switching, just in case somebody really does want to combine all five input channels. Meanwhile, the present arrangement is really, in all seriousness, an excellent one, both for those who want an accurate and accessible level-set on every input channel—a necessity in my book—and, alternatively, for those who may actually want to do some mixing and fading.

There are newly fancy tape facilities here, too, including a bypass tape output and a special tape preamplifier input that takes signal direct from a tape head and preamplifies it to the NARTB curve. (I don't get that, exactly, since I thought the NARTB tape standards merely specified the combined result of recording and playback curves added together, but maybe I've missed some new developments.) Also, 80-C uses a pair of the double control knobs, one inside the other, that we first ran into in TV sets. One of these combines loudness compensation and over-all level-set (master gain) in the proper way for useful loudness control. The other combines bass and treble roll-off and boost tone controls. Neat, economical of space and easy to use.

Finally, the 80-C has Fisher's excellent dual-toggle-switch equalization system, two vertically-operating levers, bass and treble, clearly marked in five positions each, including the new tape preamp setting. This arrangement seems to me far and away the simplest and most immediately practical for home record equalization by the average musical person, non-gadgeteer, and it's one good reason for recommending this relatively complex unit to the timid.

Generally speaking, I'd say the Fisher 80-C is an admirable example of a maximum diversity of engineering crammed into a minimum of space with intelligence and simplicity.

4. Accessories

A brief mention is in order of a couple of accessories to good listening that don't need any very extended trial, nor much space to describe their obvious usefulness. Cabinart, the company that has specialized in cabinetry both finished and unfinished, plus assorted kits—speaker enclosures as well as equipment cabinets—is branching into this area. Recently arrived for "test" in my home are two simple record holding cabinets, a one-footer and a two-footer, the smaller one with close-up partitions for single LP records primarily, the larger with wider spaces between partitions, suiting it better to the thicker LP albums. There's also a three-footer and, I gather, the wider or narrower slots are a matter of choice; also there are optional modern-style iron-legged bases in case you want to stand these units up for good looks. Lacquered birch is the modestly good looking finish.

These are "modular" pieces, multiple-unit style. You can line up a whole row of them or stack them one above the other to expand your LP library to formidable size. (Now that most LP singles have labelling on the thin outer edge, your records can go neatly into this sort of convenient storage space without special identification.) The cost is reasonable—as Cabinart puts it, $9 a foot, table-top, plus about $9 for each two- or three-foot set of matching legs. You can house a big batch of loose LPs in each of those $9 feet.

I tried one "test" on these units immediately: I filled them with records. Very neat and unobtrusive, the cabinets having no unpleasant or inconvenient projections or elaborations.

Another slightly more drastic test I deferred—I didn't stand on them, to see whether they would collapse in a heap. The laminated plywood is strong but not very thick and I would hesitate, on the looks of them, to pile more than two of these units full of records one on top of the other. A couple of feet of LP records carry a huge poundage, as you would know very well if you reviewed them in bulk. But you won't be likely to want to triple-stack unless your collection runs into the thousands, in which case you'd better go in for second-hand letter-leger metal file cabinets with rolling drawers, as I have.

Cabinart also offers an accessory called the Levelor—"high fidelity on the level". But the five little objects inside the paper envelopes are ingenious enough. They are designed to level your turntable or record changer base. Four adjustable "legs"—better call them feet or toes—attach to the bottom of your box and adjust to fit the most irregular surface. I haven't tried them yet—they require holes. (I sort of hoped they would just stick on with tape or something, but common sense says no.) The best part of the Levelor kit and worth the whole thing is a bubble level. Not a lengthwise level, such as the usual carpenter's model, but the first *round*, all-directional level I happen to have run into.

If you've tried to square off a turntable plate for levelness with the usual carpenter's one-way bubble level you know how tricky it is to figure the tilting angle accurately. It's try and try again. The round level tells you instantly which direction is uphill, at a glance. Excellent! From there on out I generally use paper matchbook wedges and the like, but the Levelor legs, I hasten to say, are better practice.

The only level problem this kit leaves me with is a real tough one that maybe Cabinart didn't think of. What are you going to do with a *curved* motor board—warped? Maybe I shouldn't even whisper

it, but an awful lot of wooden motor boards curl gently, after a few months of summer humidity and winter drying. Even the best. Then, of course, your level bubble, quite rightly, gives a different slant at every point on the board. The answer—take to the table itself, rigid metal, for your leveling. And don't forget to match your separate pickup base to the same level. It may well be off somewhere on that gentle curved board-horizon, tipped at an off-level angle to the motor itself.

5. Hi-er Than Ever

In this country of ours you can judge the current state of any Movement by the ads that come forth.

A Movement, of course, is an idea that starts quite reasonably and logically, is condemned good-naturedly by the Many as a speciality of interest only to the Few—then is suddenly taken up and Catches On; whereupon the moguls of publicity hop on the bandwagon and go about methodically making it into a Craze. The Movement finally peters out into absurdity and utter frustration when the publicity plugging gets so far-fetched that nobody can figure out who's saying what and the public—at least the Few—look elsewhere for something new, for the Few alone.

Now you can apply all this, if you will, to that once-reasonable Movement called High Fidelity. Witness a few of the current items I've been clipping, just out of curiosity.

Item: Joe Zilch (a pseudonym, of course) last summer blasted forth sweet music over Sheepshead Bay, near New York, for the edification of yachtsmen and fishermen. He announced to the press that he had improved upon high-fidelity reproduction to the point where his now amounts to Total Fidelity. He's an electronic engineer. The Times headed this item TOTAL FIDELITY HEARD. Maybe.

Item: Full page ad in color, Sunday paper, announces huge ½ price sale Twin-Speaker Hi-Fidelity phonograph, table model, for $39.95. It boasts not only Hi-Fidelity, but 3D. "Stereophonic Sound for Stereophonic Hearing." Picture of a beaming man's head and two ears, each spouting the word 3D. "Twin Hi-Fi Speakers for Natural 3D Sound." If this isn't utter confusion, I ain't never seen it.

Item: A medical trade advertisement for something called Achromycin Tetracycline, an antibiotic. The ad goes to Doctors only, of course. It says at the top: "*FAR WIDER RANGE—the organist of today has at his command the vast tonal and dynamic resources of the four-manual giant, undreamed of in the day when the parlor harmonium was a main source of family entertainment.* (Picture of a huge organ console) *Achromycin Tetracycline represents a comparable advance . . .*" etcetc. Fine publicity idea, but slightly garbled. What *kind* of "wide range"? Even a parlor harmonium—in the original—is wide-range! And this ad writer probably didn't know about the new back-to-the-Seventeenth-Century organ movement that has the organ builders rushing hither and yon the country over, rebuilding the giant four-manual models into authentic Baroque organs, according to the best wide-range ideas of the 1600's.

Item: An ad that says "*His taste is changing . . . how about yours?* Picture of a man listening to a "hi-fi" phonograph, table model mounted on fancy modern iron legs. The product? Whiskey.

Item: Comic strip, "The Saint." Thoroughly unpleasant hi-fi bug goes into ecstasies in hi-fi store over highs and lows, turns out to be the villian of the story. (I didn't see how it ended.) Hi-fi on the wrack! That comic strip artist really had a peeve about it, and didn't spare us a thing.

Item: New children's record, music by George Kleinsinger (Tubby the Tuba), all about Woofer and Tweeter, the pair who live in your phonograph. They get into a fight and Tweeter tries to put on his own hi-fi concert—but nobody likes it. Reconciliation—and there they are, right inside YOUR phonograph, playing away! Oh-so-gentle indoctrination into the wonders of highs and lows. (Take it from me, when George Kleinsinger writes a children's piece about anything it has ARRIVED.)

That exhausts my "Progress of Hi-Fi" file for the moment.

RECORDS

(*from page 57*)

"Grand Canyon," though the technique is similar.

And it's better music. Better tunes, more solid, more interesting harmonic progressions though not as ickily colorful as "Canyon." All, of course, within the strict conventional bounds of this sort of music, at which Kostelanetz is expert. Fine hi-fi, especially the bowling scene (Rip Van Winkle), thunder-drums and real pins and balls.

Sauter-Finegan: Concert Jazz.
RCA Victor LPM 1051.

RCA's fabulous Sauter-Finegan combine has been edging out of jazzpops and towards the big 12-inch classical label ever since the fabulous Liebermann Concerto for Jazz orchestra and symphony orchestra of last year. This is one new variety of "symphonic" jazz—or as the label says, concert jazz. I gather most of it is written out. The style is expanded considerably beyond straight popular jazzband stuff, with tricky titles, some numbers that scarcely sound even like written-out jazz. Through much of it runs the peculiarly cutting, sharp dissonance, the teeth-gritting on-edge quality that is, for better or worse, the 1950's, as expressed in big-band jazz. Natural stuff, of course, for hi-fi and this is a hi-fi diller.

You can have the vocals and the more sentimental numbers—I like the tough, taut ones myself. And you can have the musical travelogue, with poetic narration, called "Pictures from Sauter-Finegan Land." Plonk, we're right back into old-fashioned film background music, unrelieved! Sometimes I wonder whether these boys know what their own best talents are. Like backwoods folk singers who think they ought to sing "Home Sweet Home" and "Drink to me Only".

Gerald Moore: The Unashamed Accompanist. Angel 35262

Here is a complete popular lecture, as given on many a lecture platform by one of the finest piano accompanists alive, the modest and engaging Gerald Moore. Don't get the wrong idea—this is not highbrow lecture, though it is concerned mainly with Schubert and Brahms. It's light, playful, even pretty corny, full of anecdotes that are a wee bit apologetic and don't always quite come off. And it's sort of long and not at all over-crammed with ideas. Could stand a few more, even.

But what makes magic here is not the lecture, not the pleasing, easy voice, the impromptu atmosphere, but simply the music. Every time this unassuming lecturer touches the piano to play an illustration for you—he becomes a genius, one of the authoritative titans of the keyboard. Another wizard—and, as he explains things, you can hear how and why, even if you've never heard a Schubert song other than "Ave Maria". For those who do know Schubert and know his piano accompaniments, the brief examples of Schubert playing here will be revelations.

BRIGGS CONCERT

(*from page 31*)

that the gain and phase in the audio range should be similar and that conditions for stability should be met. The first two requirements offer no difficulty as these are normal characteristics of any high-grade amplifier. The stability requirement is more difficult to predict but it will always be met when each amplifier is inherently stable and completely independent of load conditions. This is the case with the QUAD design so that no selection of amplifiers or special testing is required.

The system operates as a well regulated voltage generator and is unaffected by load. Therefore Mr. Briggs is free to switch in all or any loudspeakers, with and without crossovers and without regard to matching. If he connects a single 15-ohm loudspeaker (or a complete three-way 15-ohm system) he can draw up to 15 watts output. If he connects two 15-ohm loudspeakers or systems then each will draw up to 15 watts, the power will be doubled and so on up to the maximum of 60 watts. If he exceeds this 60-watt demand the individual maximum wattage on each loudspeaker will fall accordingly.

The system may be likened to the domestic electric light system, the generator supplying the wattage demand of the lamps in circuit up to its maximum capacity. When we switch off a light at home we do not have to replace it with a dummy load.

The apparent source resistance of the output is 0.25 ohms. It will be observed therefore that the damping factor will change with the number of speakers over a range of about four to one. This is of course insignificant. A loudspeaker designer is careful to design his unit and enclosure to give a level response with the minimum overshoot consistent with cabinet size. The resistance element in the mechanical system to achieve optimum design is derived from the electrical speech-coil resistance on the assumption that this is the controlling resistive element. Provided then that the apparent source resistance of the amplifiers is small compared to the speech-coil resistance its actual value or sign is quite immaterial.

Loudspeakers

Four complete Wharfedale three-speaker corner assemblies and two Wharfedale Super 8's in R-J enclosures make up the speaker complement.

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF

AUDIO, published Monthly at Lancaster, Pa., for October 1, 1955.

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

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(Signed) HENRY A. SCHOBER, Business Manager.
Sworn to and subscribed before me this 21st day of September, 1955.
(Seal) ROBERT FALTINGS, Notary Public.

State of New York. No. 30-6228950. Qualified in Nassau County. My term expires March 30, 1956.

The main orchestral items were reproduced on the four corner assemblies. These were spread out across the stage and therefore did not enjoy the effect of corner loading for which they are designed. The average air load at low frequencies is thus reduced by a factor of four so that the output at low frequencies approaches 6 db down. This could well be a subject for criticism. To correct it would entail brick walls or larger cabinets. The latter was rejected since one of the features of the demonstration was that all standard commercial equipment was used. Due to the inevitability of standing waves the discrepancy is musically not objectionable.

Solos, quartets and small orchestras were reproduced on one or two loudspeakers, the aim being to reproduce a size of sound source in keeping with the size of the original.

Minor modifications were made to the corner assemblies. These normally stand on the floor. For easy handling, casters were fitted and it was found to be necessary to increase the rigidity of the base of the cabinet in order to simulate "floor" conditions.

Directivity was also modified by tilting some of the high-frequency units to approach the desired dispersion for Concert Hall conditions.

These modifications do not seriously invalidate the statement that standard commercially available equipment was used since they do not affect the inherent quality of the loudspeakers but merely apply it in the best manner to suit the prevailing conditions.

The R-J enclosures are a design compromise for use where there may be space restrictions under home conditions. The demonstration of some items on these small enclosures was interesting in showing their capabilities in a large hall.

Power Indicator

An ingenious device which contributed much to the demonstration was due to the efforts of Mr. E. M. Price. This was an indicator visible to the whole audience showing the wattage being consumed by the loudspeakers at any moment. The device took the form of a row of neon lamps coupled to tappings on a transformer. Each neon lamp was arranged to strike at a signal level 3 db higher than its neighbor, thus as the power increases, more and more neons come alight. An adjacent calibrated card clearly indicated the levels.

The neons give an indication of peak voltage and are not a true indicator of watts since this is dependent also on the waveform. They do, however, show at any moment the true amplifier size (in watts) necessary to produce the sound being heard.

Assuming that a live group of artists gives full musical satisfaction in a Con-

cert Hall, it is interesting to convert these wattages to that required in an average living room to produce the same sound intensity at the ear as heard in the Concert Hall. The results are very small powers indeed. However, the psychological effects in the two media cannot adequately be assessed and it is perhaps as well that each individual can set his volume as he pleases.

Most records were played with level bass and treble balance and where any adjustment appeared necessary it never exceeded 2–3 db. About half the recordings needed some degree of filtering. That is to say the reproduced bandwidth was limited to the useful recorded range and the slope of attenuation outside this bandwidth was adjusted to follow approximately the inverse of the distortion/frequency curve inherent in the program. In this way the best possible quality is obtained from the particular program source.

The acoustics of Carnegie Hall differed from the Festival Hall mainly in balance, Carnegie being rather more alive at low frequencies and rather more absorbent at the high end. This did not affect the balance settings in any way. An orchestra would sound different in the two Halls so that to be natural, record reproduction should show similar changes from Hall to Hall. It follows that volume and balance settings which sounded natural in the Festival Hall should sound equally natural in Carnegie Hall. This was in fact the case and virtually identical settings were used in both Halls.

So much for the equipment. The important question, indeed the only criterion, is how it all sounded. Was it possible to listen to it as music without being conscious of Hi-Fi or any other Fi? The answer must be left for others to decide. (For one opinion, see Editor's Report, page 14.)

DESIGN OF BIFLEX LOUDSPEAKERS

(*from page 25*)

The principles outlined above provided the foundation for the design and construction of experimental speakers. Free-field measurements in the acoustical laboratory provided the means for evaluating trial designs and testing the effect of variations. The end point in the development is illustrated in the frequency response shown in *Fig.* 5 which is the measurement made on a 12-inch speaker employing the double-compliance cone, a 1.8 pound Alnico V magnet and a 3-inch voice coil. The small irregularity that may be seen in this curve just below 1,000 cps was a serious valley 12 db deep before the resistance of the mid-compliance section was raised to the optimum values and the exact detail of this section was perfected. Since the response was recorded without the benefit of rigid corner walls for which the enclosure used in testing was designed, the frequency response at 30 cps is considerably lower in amplitude than if the corner walls in a normal room were used. The response down to 30 cps as measured in an Altec 606A corner cabinet placed in a corner of a typical hard walled room is appreciably improved as shown by the dotted portion of the curve in *Fig.* 5.

The wide-range, smooth, flat characteristic, achieved at an efficiency equal to that of the top-quality, single-cone speakers without a penalty of higher manufacturing cost, is considered a substantial fulfillment of the objective of the development. The response depicted may be considered representative of the characteristic obtainable with the Biflex principle. This loudspeaker well represents the Biflex principle, having frequency response limits in the order of 40 and 15,000 cps when placed in a well designed bass reflex corner enclosure.

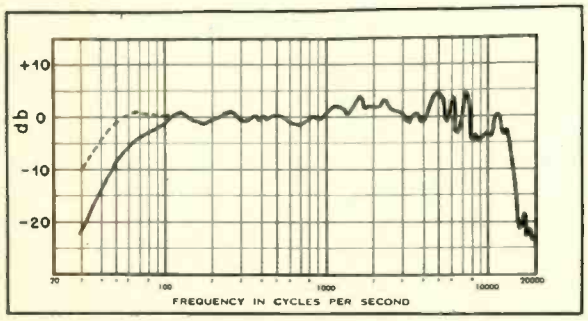

Fig. 5. Frequency response of a 12-inch Biflex loudspeaker, Altec Model 412A.

ABOUT MUSIC

HAROLD LAWRENCE*

An Easy Delivery

Bruno Walter

ONE MORNING early this spring, a hand-picked orchestra assembled in Columbia's 30th Street studio for the first rehearsal session with Bruno Walter of Mozart's Symphony No. 36 in C ("Linz"). Walter ascended the podium and greeted the musicians: "Good morning. Now, gentlemen, we rehearse. . . ." In the control booth, tape reels began to revolve. As on several past occasions, David Oppenheim (Columbia Masterworks Director of Artists and Repertory) had given instructions to have the rehearsal recorded. This session, however, was different. From it emerged a unique album entitled, "The Birth of a Performance," which included the entire rehearsal and the finished performance of the Mozart symphony. No one in the hall was aware that the microphone directly in front of the maestro was transmitting every note (missed and struck), as well as every word uttered by the genial director who was shaping phrases, coaxing accents, and swelling out crescendi.

Rehearsals had been recorded before. The most famous (or, rather, notorious) were the Toscanini sessions with the N.B.C. Symphony, issued sub rosa. The hoarse, impatient, pained exclamations; the terrifying silence that preceded an emotional thunderclap; the sarcastic "*Vergogna!*" leveled at some poor player; the appeal to the saints; and always the admonition: "*Cantando, sempre cantando!*"—those were some of the trademarks of the Toscanini rehearsal. The impression arising from these boot-legged recordings is that of a tyrant, and not of the benevolent variety. Rehearsals were a great strain on the orchestra. Highly sensitive to detonation, Toscanini's temperament was a thing to be respected.

The first commercial release of a rehearsal was included as a bonus to purchasers of one of the Casals Festival albums. In this session, Isaac Stern performed the opening movement of Bach's Violin Concerto in A Minor under the direction of Casals. In the past five years, Columbia's tape machines have seldom remained idle during rehearsal time at important sessions. One of the most illuminating and entertaining of these sound documents is the rehearsal of *The Rake's Progress* under the baton of the composer. Stravinsky's incisive, sturdy approach is conveyed in no uncertain terms. His conducting is a model of clarity. When the rhythmic contour of a certain phrase eluded one of the principals (who shall remain nameless here), Stravinsky emitted a "No" with the finality that only a Russian can impart to the word. After a few repeats and several more interruptions, the singer finally broke down. Cutting across the ensuing half-apologetic, half-protesting stream of words like a foghorn, Stravinsky's voice is heard: "But it is absolutely contradictory to all logic!"

After hearing a radio broadcast of excerpts from the *Rake* rehearsals, some listeners were inclined to feel that the rehearsal itself was contradictory to all logic. At least, so it seemed to some non-musicians, and even to a few musicians not equipped with the score. A full orchestral score is provided with "The Birth of a Performance." This and Walter's thoroughness, patience and cordiality make the musical journey a delightful as well as an instructive one. It is also an eloquent reply to critics of Walter's "Viennese nonchalance." True enough, this is no drillmaster, no perfectionist concerned with precise attacks for their own sake. With Walter, the evolution of a theme, the exact degree of orchestral "decay," the concern for instrumental timbre and, above all, for the singing quality of Mozartian melody, are primary objectives.

Take the first movement of the *Linz*. At the fourth bar of the Adagio introduction, bassoons and lower strings play a repeated-note pattern leading into a melting theme taken by violins. Walter interrupts: "No I'm not happy. No accents . . . one string, not four." Four bars later, at a *fp* chord: "These accents are always a little *after* the note." The subtle smoothing out of accents in one phrase, and their broadening out in another are two examples of the care and precision with which Walter works out his conception of the score.

Few pangs accompany the birth of this performance. There are no tantrums, no caustic remarks, no baton-rapping, and no foot-stamping. Dissatisfaction is expressed in no more severe terms than: "No, I am

* *26 W. Ninth St., New York 11, N. Y.*

still not happy.'' Instead, Walter exhorts his men to ''share'' the musical experience with him: ''We must try it this way, my friends.''

Last year, the Symphony of the Air (the former N.B.C. Symphony) gave a conductorless concert at Carnegie Hall which the late Olin Downes described as ''exciting and impressive.'' He hailed the organization's remarkable unity but went on to say that ''The program was of works that Toscanini had rehearsed and directed with these players. His musicianship and exacting taste in regard to the smallest detail was everywhere in evidence.'' Although it was pointed out that the men worked out their own interpretations, the results belied their intentions. These were Toscanini's ideas, pure and simple. Even the sound of the orchestra was his—taut and wiry. This may have been the first time an orchestra of this stature had attempted a performance without a conductor, but it only served to illustrate how essential he is. Like a pianist, a conductor is recognized by his tone, no matter what orchestra he leads. A few minutes under Stokowski, for example, and Toscanini's N.B.C. Symphony developed the luscious legato of the Philadelphia Orchestra. In the same way, the pick-up orchestra performing the *Linz* Symphony is molded into a reflection of Bruno Walter's special musical thought.

The LP era has given birth to sales ''gimmicks'' of all kinds: packaging, ''complete editions,'' extra-musical tie-ins such as RCA Victor's *Romeo and Juliet* collection which brings together ''for the first time in one package three major musical compositions based on the Shakespeare play'' (LM 6028), etc. ''The Birth of a Performance'' may very well belong to the category of the sales gimmick. But its inherent musical values far transcend the commercial implications. It has given us a deeper insight into Mozart's score and has brought us closer to Bruno Walter.

It is impossible to predict at this point the success of Columbia's venture. Should sales figures prove encouraging, more of the same may be forthcoming. If so, there are a pair of factors to be taken into consideration. First, not all conductors are as phonogenic in rehearsal, or as interesting musically, as is Walter. Second, would the knowledge that a rehearsal is being taped have the same effect on conductors and players as the TV camera has on Congressional subcommittees? In any event, Columbia is to be congratulated for a stimulating and rewarding project.

AUDIOCLINIC

(*from page 32*)

it indicates that the decoupling capacitor has aged, with a consequent decrease in capacitance. If the amplifier was built by an experimenter, and the ''motorboating'' has persisted from the start, it probably means that he used one or more decoupling capacitors of too low a value. A simple way to locate the trouble is to connect a fairly large capacitor (perhaps 40 μf) in turn across each of the decoupling capacitors. Probably one will be found which, when the test capacitor is placed across it, will reduce or completely eliminate the trouble. This will show that the old capacitor must be replaced. Refer to *Fig.* 2 for aid in locating these capacitors. Here we have a typical plate circuit of a vacuum tube. Notice that from the B+ side of the plate load resistor, R_P, we go through another resistor, R_D, the decoupling resistor, to B plus. R_D should be at least 1/5 of R_P or there will be additional source of ''motorboating.'' The capacitor, C_D, which goes from the junction of these two resistors to ground, is the decoupling capacitor which we have been discussing. In audio work these capacitors are usually electrolytic types, whose values range from approximately 8 μf to approximately 40 μf. Decoupling capacitors for r.f. circuits are generally much smaller in value.

A defective screen bypass capacitor in a pentode circuit can provide another way of introducing unwanted coupling through the power supply. When the screen is not bypassed sufficiently, an extra stage is effectively added to the amplifier. In other words the pentode acts like two stages instead of one. The first of these works between the control grid and the screen, and the second, acting like a directly-coupled amplifier, works from the screen to the plate. The first of these stages is obviously not decoupled. The screen bypass capacitor, C_s as shown in *Fig.* 2, places the screen grid at a. f. ground potential and still permits the necessary d.c. voltage to be present on the screen. Values for screen bypass capacitors range from approximately 1-μf to approximately 8 mfd in audio work. R. f. screen bypass capacitors run much smaller in value, depending upon frequency.

THE CW HORN

(*from page 20*)

Phase 4: Lay into the maze the woofer and tweeter leads stapling them to part 10 near the throat edge so that they will not fall back into the horn. The lead to the amplifier should be led out through the center of the back through a hole in which the cord fits snugly.

Phase 5: At this point, the top edges of the pieces assembled on part 4 should be checked. Their upper edges must lie in a single plane. Irregularities should be smoothed out to insure that when part 18 is applied, a continuous air-tight seal will result. Apply glue generously to the upper edges of these pieces and then fasten the upper side, part 18, into place with screws or nails.

Phase 6: Complete the box by fitting parts 19, 21, and 22 which together with part 7 form the speaker panel seat. Make sure that the seat is flat. Apply the necessary gasket material to assure an air-tight seal when the speaker panel is fixed in place.

Phase 7: Bolt the speakers to the speaker panel using gasket material on their rims to assure airtight seals. Connect the speakers, being careful that the cones are properly phased. Fasten the speaker panel into place with screws and the enclosure is ready to use. The mechanical design of various loudspeakers will dictate the design of the speaker panel. It may be necessary to use thinner plywood for this part (20) in order to avoid the possibility of the speaker rims or speaker panel projecting past the front edges of the box. It is a simple task to mount a pair of 8-inch speakers with their rims outside the panel. When the rims must be mounted on the inside, as is necessary with Jim Lansing speakers, make two panel boards exactly the same length and width with thicknesses of ¼ and ¾ inch. On the thicker one cut two holes which will be tangent at the center of the panel and have radii equal to the radius of the speaker rim. On the thinner one cut two holes with 3½ in. radius making sure that when the two pieces are fastened together the holes in the two different panels will be concentric. The ¼-in. piece mounts the speakers, the ¾-in. piece provides an effective seal on the panel seat.

The enclosure as it has been developed was designed to fit into a cavity in an existing radio-phonograph console. It can be used in a console especially designed for it or to fit into a cavity in the wall of a home. When specifically providing a cavity for one of the CW Horns allow a space of ½ in. or more completely around the sides, ends, and front, in order that the enclosure may rest on two ½ × 1 × 16 in. strips of felt or rubber. This provides a measure of isolation which is important in preventing acoustic feed-back.

In situations where grill cloth is not needed it is well to tack plastic or glass —not metal—window screen over its front to prevent the box from becoming infested by insects. Caution: in designing grill cloth frames avoid encroachment upon the mouth area of the horn. An excellent hardware for making snap-on-and-off grill frames is to be found in Johnson 108–75A banana plugs which are available in most electronic supply houses.

The enclosure built of fir plywood and held together by nails or screws, the heads of which are visible, needs decoration to produce an accepable piece of furniture. Certainly most any builder can develop a satisfactory solution to his specific problem. There are many fabrics, plastics and wood veneers which may be used. The box may be laid on its side if you wish. Development of a satisfactory conversion is an interesting project. Two such units at opposite ends of a large equipment cabinet serve as a stereophonic system when connected to a two-channel amplifier; when paralleled, they provide a wide "monaural" sound source.

Many have given assistance and encouragement in experiments with the enclosure and the preparation of this article for publication. I am especially grateful to Dr. Wm. M. Rust, Jr., Dr. M. R. MacPhail, Mr. Frank Feagin and Mr. Alex Frosch of Humble Oil & Refining Company; Mr. Carl R. Wischmeyer of The Rice Institute; and Mr. L. W. Erath of Southwestern Industrial Electronics Company, all of Houston, Texas. Correspondence concerning this "CW Horn" is invited.

List of Materials

4′ × 8′ sheet of ¾-in. plywood.*
½ lb. of glue (Weldwood or Cascomite).
1 Gross #6 or #8—1½" wood screws or 8d finishing nails (1 lb.).
1 Box of 1-in. wire brads.
⅛ lb. of 4d finishing nails.
Gasket material: 1/16- or ⅛-rubber or cork for speakers and speaker panel. Sheet 12" × 36".
* A-D Exterior grade preferred.

List of Parts

		Bevel:
1—17" × 31½"	Back	
2—17" × 17"	End	
3—17" × 17"	End	
4—17" × 33"	Side	
5—17" × 4"	Fillet	45°–45°
6—17" × 7"	Fillet	45°–45°
7—17" × 5-7/16"		
8—17" × 18-9/16"		85°
9—17" × 8¼"		78°–85°
10—17" × 13¾"		31°–84°
11—17" × 2⅛"		84°
12—17" × 11¼"		78°
13—17" × 2¼"	Fillet	40°–44°
14—17" × 2½"	Fillet	46°–49°
15—17" × 19⅜"		86°
16—17" × 3½"	Fillet	41°–45°
17—17" × 3¾"	Fillet	45°–48°
18—17" × 33"	Side	
19—17" × 2"		
20—17" × 10¼"	Speaker Panel	
21—8¾" × 1¼"	Panel End Support	
22—8¾" × 1¼"	Panel End Support	

CATHODE CAPACITOR

(*from page 23*)

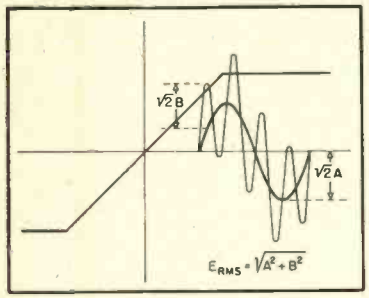

Fig. 8. Graphic representation of possible maximum voltage resulting from mixing two signals of slightly different frequency and of the same amplitude, as in the CCIF method.

vacuum-tube voltmeter. In accordance with the above, maximum power level is equivalent to an output voltage reading of about 9.3 volts on these curves.

The curves of *Fig.* 9 were obtained by maintaining the indicated input frequencies constant, varying the input voltage up to overload and above, and measuring the first-order difference frequency. The tubes used were 1614's and the difference frequency was 400 cps. Notice that although the difference in distortion is slight, it is almost always lower when the cathode resistor is bypassed. The same results were obtained with 5881's and KT-66's.

The curves of *Fig.* 10 were obtained by keeping the input voltages constant and varying the input frequencies. This was done for three difference-frequencies, providing a considerable amount of range overlap as shown. The tubes used were KT-66's. Again it is seen that the capacitor effects a slight but definite improvement. (Note that each difference frequency has separate distortion ordinates in *Fig.* 10).

As a final check the amplifier square-wave response was observed for different amounts of current unbalance. With unbalanced currents up to 10 ma in either direction there was no discernible difference in the output wave shape as the capacitor was added or removed at frequencies from 20 to 20,000 cps. At low frequencies there was a noticeable rounding of the trailing edges as the unbalance exceeded 10 ma. (See *Fig.* 11) These results were obtained with any of the three types of output tubes.

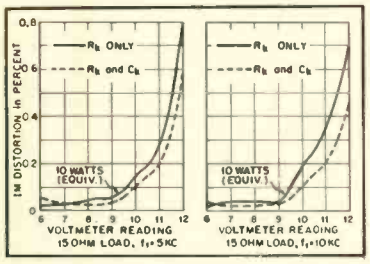

Fig. 9. Effect of capacitor on CCIF intermodulation measurements at two different areas of the frequency spectrum.

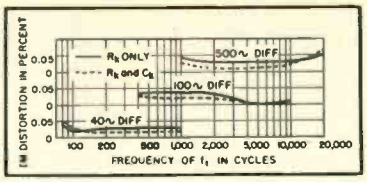

Fig. 10. Effect of capacitor on CCIF intermodulation measurements when difference frequency is varied. (The three pairs of curves are plotted to different base lines.)

From the foregoing experiments at least one curious result stands out: In a Class A amplifier the use of a bypass capacitor across the output cathode generally reduces the intermodulation distortion, although it may either decrease or increase the harmonic distortion.

The decision as to whether or not to use such a capacitor depends mainly on the magnitude of the distortion. If it is very small, then it may be safely left off, with no possible audible difference. If it is only moderately low, then the use of a bypass capacitor is advisable.

All of the foregoing applies to a Class A amplifier only. In the case of a Class AB amplifier the bypass capacitor is absolutely necessary if the amplifier is to perform within the modern limits of high fidelity performance.

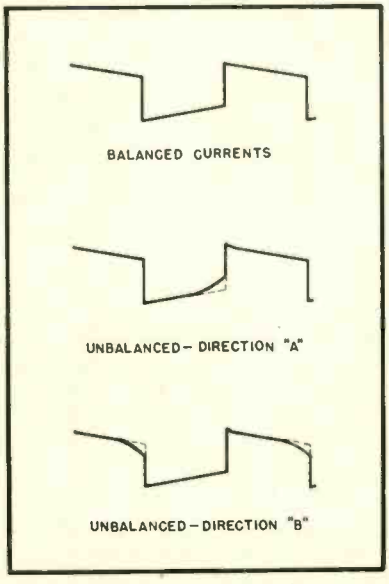

Fig. 11. Effect of current unbalance on square waves. Note that only the low frequency is affected, as indicated by rounding of trailing edge of wave.

THE VU METER

(*from page 38*)

When mounting the VU meter, careful attention must be given to the panel on which it will be placed; for these instruments are affected by mounting in steel panels due to the heavy flux necessary to the proper functioning of the meter. VU meters are normally supplied for mounting on non-ferrous materials, but are available on special request for use on steel panels provided that the thickness of the panel is specified in the order.

Use on 150-ohm Lines

Use of the 150-ohm audio transmission line is becoming more and more widespread, especially in television and frequency-modulation systems. To adapt the meter for use in this application, it is only necessary to add a matching transformer similar to the General Radio Company type 941A. This unit has a turns ratio of 1:2 and a resultant gain of 6 decibels.

The primary of the transformer has an impedance of 1875 ohms, obtained by multiplying the 150-ohm line impedance by the usual 12.5. Consequently, the secondary has an impedance of 3750 ohms, but is loaded with 7500 ohms (3600-ohm resistor plus 3900-ohm pad) which is twice its impedance. This serves to double the effective impedance of the primary which reduces the signal to the bridging system by fifty per cent. However, the 6 db gain of the transformer doubles the level and the perfect balance of impedances and levels is maintained.

All this is shown in *Fig.* 6, which also shows a fixed pad which may be inserted in the line. This pad is necessary due to the power limitations in the transformer and is designed to be switched in at the 16-VU point wherein it provides 12 db of attenuation. The variable attenuator should be so designed that it starts again with minimum attenuation at this point; that is, since the pad provides the required 12-db loss, the attenuator should give zero loss at this point and then work on up as before. Consequently, the construction of the variable attenuator switch will be the same as in Table 1 through the 15-VU point; after this the attenuation repeats from zero all over again.

Although the 4-in. front-illuminated VU meter is particularly popular, there are no standards pertaining to the meter's size, shape and method of illumination. Meters have been made in sizes of from two to seven inches, round and rectangular, rear illuminated, front illuminated, and non-illuminated.

The author has had the opportunity of comparing three other meters with a type 30 Weston model 862, which was arbitrarily (but with some justification) set up as the standard of comparison. All were four inch, front illuminated units and virtually identical in outward appearance, but from mere observation of their action, differences in operation were apparent.

Meter A was so similar to the 862 that its substantially lower cost made it the most appealing buy. Meter B would bounce its pointer off the pin when the voltage, either program or signal generator, was removed. Meter C, employing a vacuum-tube-voltmeter type of circuit, had a very slow attack and an extra quick return when voltage was removed. While these comparisons cannot be regarded as conclusive or even completely valid, they do tend to prove that differences are easily noticeable, and that such differences exist even in manufacture.

Whether the present VU meter will continue as the standard of the industry remains to be seen; but while it has this position, it is obvious that only through proper and uniform construction and usage can we ever expect to achieve any semblance of accuracy and reliability in volume level monitoring.

HI-FI STANDARDS

(*from page 44*)

in ear-shattering. The writer has yet to experience at a live concert, even during *fortissimo* passages, an assault on his ears that compares to hi-fi assaults he has weathered. It is interesting to note that certain hi-fi demonstrations preclude intelligible conversation which is not shouted, while whispered conversations in a concert hall are liable to prove extremely distracting and annoying to one's neighbors. It is the sound intensity level at the ear, not the power of the orchestra, that we are trying to reproduce for musical results.

Any sound component not present in the original program material, other than distortion products, is referred to as noise, even though it may be periodic and not conform to our strictly scientific definition. Hum, rumble, surface scratch, tube hiss or other circuit noise and similar disturbances tend to destroy the auditory illusion and must be kept to a minimum.

A standard for satisfactorily low noise has been established by the FCC for FM broadcast stations. It is that the power ratio of the maximum signal to the noise must always be at least 60 db; this represents a ratio of one million to one.

FLETCHER-MUNSON

(from page 29)

it sound like the same 70 db of dynamic range available in the mid-frequencies.

In the statements just made we have assumed that a dynamic range of 70 db in the middle and upper frequencies is recorded, while a dynamic range of only 30 db in the region of 50 cps gets recorded. But is this true? If the instruments played are capable of yielding a dynamic range of 70 db in the middle and upper register, isn't it also probable that a dynamic range of 70 db may occur at the low frequencies also? If this is the case, then the lower 40 db or so of the original music will get lost and only the top 30 db of actual dynamic range will be heared, as an apparent variation in loudness corresponding with 70 phons.

This may, of course, be natural, but it is not necessarily what we feel we would like to hear. If the string bass is playing, we feel that we should hear it, even if it happens to be played quietly. But sometimes, in a live performance, low frequencies may be inaudible because their energy level is too low. So, even in this circumstance, it would be advantageous to raise the level of the lower section of low-frequency dynamic range so as to bring all recorded material at this end of the spectrum into the range of audibility.

This suggests that what is needed is a compressor that will operate only at the low frequencies—or rather will operate progressively toward the low frequencies —while not compressing the middle and upper frequencies. Electronically this is not a very difficult problem. And it will be quite easy to work out a circuit that will do this automatically.

What seems to be required is a compressor that will increase amplification at the low frequencies of the low signal levels so as to compress a dynamic range of 70 db of intensity, corresponding with the 70 db in the middle range, up into the intensity corresponding with the loudness contours at the low frequency end, and which only occupy an intensity range of 30 db. We need something like 40 db of compression, which will be gradually effective as frequency becomes lower.

This should not be difficult to achieve, by using a shallow crossover arrangement between the low frequencies, and the medium and high frequencies, passing the low frequencies through the compressor, and recombining the signal after compression. Alternatively the compressed low frequencies could be fed directly to an amplifier designed to supply only the LF unit in the loudspeaker system, while the middle and high frequencies are fed through an amplifier to the middle and upper range speakers.

Now we run into the question of what signal should provide the control for the compressor? The first obvious answer is to use the low frequencies themselves, taking a control signal from the output of the compressor, following normal compressor practice. But here another question arises: will the control taken from the low frequencies themselves compress the range into the correct part of the available dynamic range to correspond with the dynamic intensity of the moment in the middle and upper register? Maybe some coupling should be made to the amplifier section handling the middle and upper register, so that the low-frequency gain could be controlled in some measure by the signal level at the middle and high frequencies?

It is obviously not desirable for the low-frequency level to be controlled *entirely* by the signal level of the middle and upper registers, because in this arrangement the absence of middles and highs altogether—such as would occur when bass instruments were playing a solo—would result in considerable overamplification of these bass instruments.

It would seem preferable that the principal control should be derived from the low frequencies themselves, so as to insure that whatever level is recorded at these frequencies is within the dynamic

range acceptable to the ear according to the Fletcher-Munson curves, and approximately in the correct position in the dynamic range to represent the apparent loudness desired. Then an overriding control derived from the middle and upper registers, serving to modify the control derived from the low frequencies themselves, might conceivably improve the over-all result.

Some readers by now will be thinking this sounds like a wonderful idea: why didn't he go ahead and try it out, and then give us a full report of the benefit of this wonderful system? Because the writer is aware that there are limitations to the possibilities of this idea. And so he wants to call attention to the possible limitations at the outset, in the hope of avoiding repetition of the kind of thing that has happened with previous innovations.

When a new idea comes along with certain possibilities, it seems that many people want to exploit it to their own advantage (naturally), and in doing so they publicize it as the panacea the world has been waiting for. It could well be that an article written on this present aspect of "normalized lows" or whatever you wish to call it, would set off a new trend which again may be hailed by some as promising to provide the ultimate in reproduction. The writer wants to avoid providing basis for such unfounded claims by presenting the other side of the question which relates to problems in obtaining realism in the transition from one characteristic to another. This is the familiar problem of time constants for handling transients and steady tones with equal accuracy.

It is true that the problems in designing a compressor are not so pronounced as they are in designing an expander. In an expander the effect that can be caused by a transient is that it doesn't immediately go to its full dynamic level, but starts by going only half way up, and then jerkily proceeds the rest of the way. This is inherently much more noticeable than a transient reproduced through a compressor, that may be slightly overemphasized at first, and then fade away a little more rapidly than it should.

But there are bound to be some problems in selecting suitable time constants for the control circuits so that all kinds of program material will be satisfactorily handled by it. Some work is also necessary in arranging the combination controls to take care of the different kinds of program material so as to provide what sounds a pleasant balance of low and high frequencies *for all kinds of program material.*

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Industry People...

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Lester Bogen taking pride in the prototype of the new Bogen tape recorder which will be placed on the market within a short time . . . **Fred Cunow**, American sales representative for the Telefunken microphone, giving a tape interview for broadcast through the German section of the Voice of America . . . more rain . . . **Bob McPherson** of Daystrom Electric Corporation, Inc., doing a bang-up job of getting publicity for Heathkit and Crestwood tape recorders, both Daystrom subsidiaries.

Stan White and **Eddie Bracken,** strictly in the interest of experimentation rather than demonstration, delivering a measured 116-db mean level with 120-db peaks at a distance of six feet from the largest model of the Stan White speaker line—incidentally, the books are correct; being subjected to sound of such intensity for as long as three or four minutes really **does** incite nausea as well as the symptoms of mild shock . . . precipitation . . . **Rudy Bozak,** isolated from his commuting associates by floods in Connecticut, giving the old saying, "where there's a will there's a way," a workout with his one-manpower efforts to dismantle and crate a couple of tons of Bozak speakers—no heavyweight, he, either.

Frank McIntosh, designer of the amplifier bearing his name, and **Niles Peebles,** feature writer for the New York Herald-Tribune, huddling over a story to appear in the business news section of the H-T . . . **Daniel R. von Recklinghausen,** chief engineer for Hermon Hosmer Scott, Inc., overwhelmed with surprise to discover that at least, and at last, one hi-fi editor has learned to spell his name correctly—from memory, no less . . . cats and dogs . . . **Les Paul** and **Mary Ford, Sherman Fairchild, C. G.** and **Betty McProud,** and the aforementioned **J. Ford** (related to Mary only by Ampex), engaged in a powwow which, if recorded, would have settled the problems of the audio industry for years to come. EDITOR: Who said the audio industry had problems? ME: Sorry, Boss, I guess the symptoms of mild stock ain't quite wore off yet. Blame **Stan White** and **Eddie Bracken.**

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