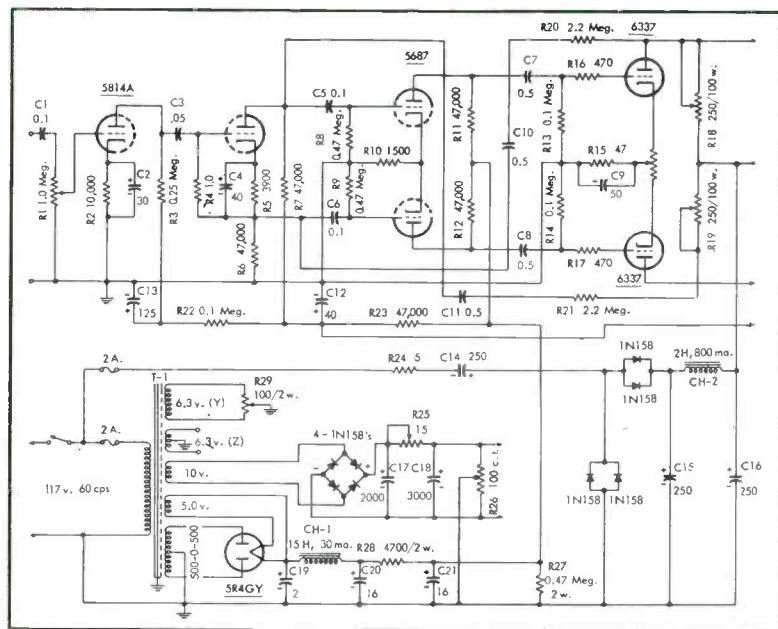


AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

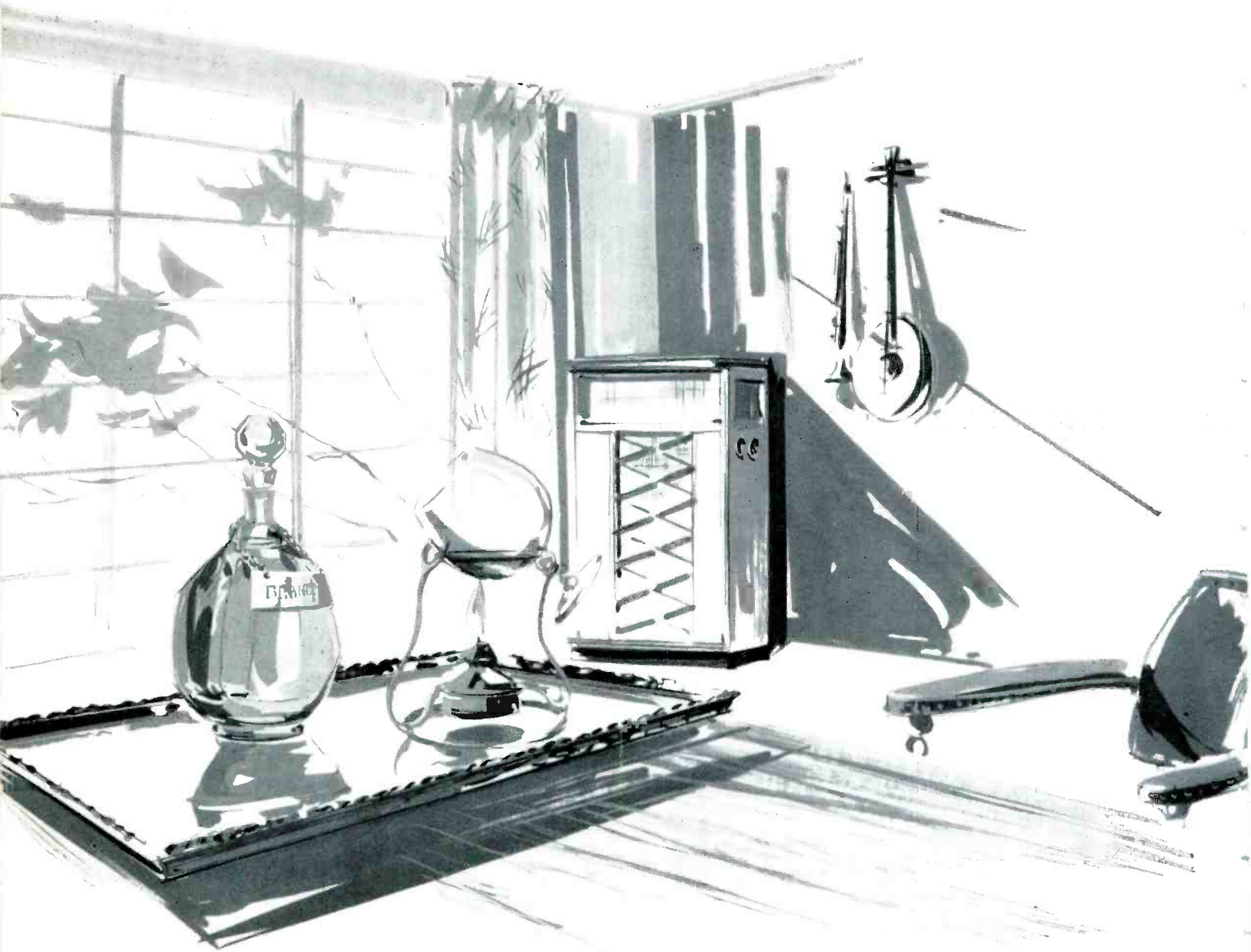


With a few simple modifications, an ordinary record changer can be improved to compare with hi-fi types with lowered record and stylus wear and reduced rumble. See page 21.



High-transconductance 80-watt triodes are used by one author in a new output-transformerless circuit to provide a usable output of 20 watts which is used to drive a high-impedance woofer and a condenser-type tweeter. See page 13.

EXPERIENCES IN STEREOPHONY
 POINT-CONTACT TRANSISTOR AMPLIFIERS
 AN OUTPUT-TRANSFORMERLESS AMPLIFIER-SPEAKER SYSTEM
 COMMERCIAL ACOUSTIC SUSPENSION SPEAKER



for connoisseurs...

Authentic High Fidelity by Jensen

The man who owns a Jensen Imperial takes it for granted that his loudspeaker has all of the acoustical perfection possible to achieve with the latest science and engineering. Seeking all of the finer things of life, he has a natural appreciation for the complete authenticity and blending of sound . . . the subtle separation of instruments . . . the sheer realism that uniquely characterizes the Imperial. He is the man who has bought a loudspeaker for the utmost exhilaration and delight that great music can give when it is a truly great *repeat* performance with *authentic* high fidelity by Jensen.

A Jensen Imperial is an indulgence in excitement. Do you dare to contemplate this luxury?
In selected Mahogany \$525.00. Satin Korina blonde \$535.00.

JENSEN MANUFACTURING COMPANY Division of The Muter Company
6601 S. Laramie, Chicago 38, Illinois • IN CANADA: Copper Wire Products, Ltd., Licensee

JULY, 1955 VOL. 39,
Successor to RADIO, Est. 1917.

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

C. G. McProud, Editor and Publisher

Henry A. Schober, Business Manager
Harrie K. Richardson, Associate Editor
Florence Rowland, Production Manager
Edgar E. Newman, Circulation Director

Sanford L. Cahn, Advertising Director



Special Representatives—
H. Thorpe Covington and Dick Knott,
7530 Sheridan Road, Chicago 30, Ill.

Mid West Representative—
Sanford R. Cowan, 67 West 44th St.,
New York 36, N. Y.

West Coast Representatives—
James C. Galloway and J. W. Harbison,
816 West 5th St., Los Angeles 17, Calif.

CONTENTS

Audio Patents—Richard H. Dorf	2
London Letter—Richard Arbib	4
Letters	8
New Literature	9
Editor's Report	10
An Output-Transformerless Amplifier-Speaker System—Curtiss R. Schafer ..	13
Experiences In Stereophony—Paul W. Klipsch	16
Commercial Acoustic Suspension Speaker—Edgar Villchur	18
Adapting a Record Changer To Hi-Fi—Adolphe F. Sterken	21
Point-Contact Transistor Amplifiers—Richard F. Schwartz	22
Sound Engineer At Work—W. H. Johnson	24
Equipment Report—REL "Precedent" FM Tuner	27
Audio ETC—Edward Tatnall Canby	28
Record Revue—Edward Tatnall Canby	30
New Products	34
"Preamp with Presence" Notes—The Z-729 Tube	43
About Music—Harold Lawrence	44
Employment Register	46
Industry Notes	47
Advertising Index	48

AUDIO (title registered U. S. Pat. Off.) is published monthly by Radio Magazines, Inc., Henry A. Schober, President; C. G. McProud, Secretary, Executive and Editorial Offices, 204 Front St., Mineola, N. Y. Subscription rates—U. S. Possessions, Canada and Mexico, \$4.00 for one year, \$7.00 for two years, all other countries, \$5.00 per year. Single copies 50c. Printed in U. S. A. at Lancaster, Pa. All rights reserved. Entire contents copyright 1955 by Radio Magazines, Inc. Entered as Second Class Matter February 9, 1950 at the Post Office, Lancaster, Pa. under the Act of March 3, 1879.

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

AUDIO • JULY, 1955

comes in every day?

CS: Actually, Mr. Carduner, we feel that a more accurate index is the attitude expressed in the mail. We watch the degree of interest . . . and the kind of listener expressing the interest. While on the subject, I might mention that one of the surprises we've had in the series has been the reaction of the ladies. In some cases, they have actually insisted that we make the program more technical as we go along. This reaction wasn't expected from them.

LC: Frankly, that is a surprise to me, as well. I suppose that all of us have heard so much about a "difference" in listening habits between men and women when it comes to high fidelity . . . that we are inclined to assume it is basically a man's hobby.

CS: Well, I suppose that the technical angle will remain largely in the direction of men, but women are taking an increasingly active part in passing judgment upon high-fidelity components going into their homes, and I believe that their present attitude is very similar to that of the average man who, up to now, had no great knowledge of audio components, but had merely heard about them, and become curious to see what they could do for him.

LC: Could you mention some of the specific subjects that are touched upon by the people that write you after listening to your program?

CS: As you might expect, they write about the things that affect them most directly. For example, if the music I play strikes them as being unusual, they want to know more about it. Whenever I put on a different or perhaps better pressing of a recording that they already have in their collections, they

(continued)



Valuable Facts Help You Install Better PA Systems

For the first time, such helpful information in a compact Handbook!

- Shows how to make sound surveys and recommendations—with factory and arena examples.
- Discusses public address requirements in auditoriums, stadiums, large rooms, etc.
- Explains operational factors of importance in public address loudspeaker systems for all types of applications, indoors and outdoors.
- Explains three major points to consider in public address loudspeaker projectors.
- Tells what the CDP Compound Diffraction Projector* is—what it does—and how it provides a PA speaker system of much greater range, efficiency and dispersion.
- Includes illustrations, diagrams, charts, formulas, engineering data, technical & architectural specifications.

*Design Patent 169,904
Additional Patent Pend.

Send for your FREE copy now
or see your E-V Distributor

Electro-Voice®

ELECTRO-VOICE, INC. • BUCHANAN, MICH.

Without obligation, send me FREE copy of the CDP Public Address Handbook.

NAME _____

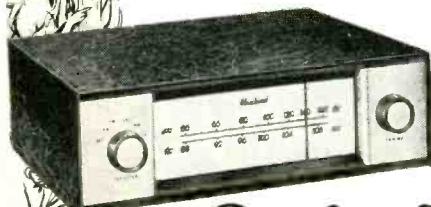
ADDRESS _____

CITY _____ ZONE _____ STATE _____

...they get a list from manufacturers, as yourself?
LC: Certainly. We have an up-to-date list of our distributors, which covers the entire country, and is available to anyone who writes for it. However, the job of informing



**unprecedented
 FM and AM
 reception
 at a sensible price**



the **Rauland**

Golden Gate
HI-FI AM-FM TUNER
 MODEL HF135

**custom quality in a
 perfect package 4" high**

Here is the tuner that offers you more for your money in every way: extraordinary high fidelity tone, exceptional selectivity and sensitivity, more gain and high output, beautiful "space-saver" design. The RAULAND "GOLDEN GATE" brings you a revelation in FM enjoyment, a new experience in AM listening.

with every desirable feature . . .

FM response, $\pm .5$ db, 20 to 20,000 cycles; AM, ± 3 db, 20 to 5,000 cycles. Sensitivity: FM—5 microvolts for 30 db of quieting; AM—5 microvolts for 1.5 volts output. Separate RF stage on both FM and AM; discriminator with dual limiters; Cathode follower with 2 outputs; AFC; flywheel tuning; FM di-pole antenna, etc.



"space-saver" design

Only 4" high—fits anywhere. Beautiful charcoal black marbled finish with brass control escutcheons. Also easily mountable behind any custom panel. Tuner may be used up to 200 feet from amplifier.

Hear the
RAULAND
 "Golden Gate" Tuner
 at your Hi-Fi dealer,
 or write for details

Rauland

RAULAND-BORG CORPORATION
 3515 W. Addison St., Dept. G, Chicago 18, Ill.

AUDIO PATENTS

RICHARD H. DORF*

EVEN THE BEST tape recorders and reproducers will not, without special compensation, reproduce sounds in their exact original time relationships. Tape stretch and other small factors accumulate to alter the time relationships so that a program with an original length of 29 minutes and 30 seconds, for example, standard for radio, may turn out to be several seconds long on reproduction. An application where time relationships are particularly important is in the use of magnetic tape for motion-picture recording. When the sounds do not precisely synchronize with the lip movements of actors and the other noise producing phenomena, the effect is very annoying, and since the viewer's ability to detect the lack of synchronization is very acute indeed, some special means must be used to obtain it.

In the past few years several methods of achieving this "lip synchronization" have been used, almost all of them involving some sort of continuous timing signal on the tape. U. S. Patent No. 2,656,419, issued to Edward N. Dingley, Jr., of Arlington, Va., discloses a new method whose principal distinction is that the same system which corrects for errors in average timing is also used to substantially eliminate wow and flutter, which are short-term timing errors. In this invention the important elements of the recording equipment are shown in Fig. 1. Figure 2 shows the reproducing setup.

The usual elements shown in Fig. 1 are the supply and take-up reels, driven in any of several standard manners, the program source, and the amplifier driving the recording head. The capstan motor, shown by the dashed circle enclosing the capstan and pressure roller, is driven by an a.c. power source, usually the 60-cps line. Note that the wow and flutter which this system eliminates is not that caused by variations in speed of the recording equipment, which is presumed to be the best in point of quality, but that caused by uneven stretching of the tape and possibly by the playback equipment.

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

The sole additional feature in the recording equipment is a timing oscillator which generates a timing frequency. This frequency, which may either be above or below the limits of the desired audio band, we will presume to be 60 cps for reasons which will appear later. If the short-period and long-time stability of the power line is good enough, no oscillator is required; but in most areas the power frequency varies over short periods and an oscillator is preferable. This 60-cps signal is recorded on the tape along with the program. It is assumed that all the normal elements such as bias and equalization and the like are present but they are not shown so that the invention can be explained in a simple way, without obstructions.

In the playback system of Fig. 2 the usual elements shown are the supply and takeup reels, the playback head and amplifier, and the capstan motor with the capstan and pressure roller. The unusual items in this drawing are the main works of the invention.

Output of the playback-head amplifier goes to the normal output channel through a bandpass filter (or a band-rejection filter) which rejects the timing frequency and thus passes on the program minus the superimposed signal. The timing frequency is fed through a sharply tuned filter to one input of a balanced modulator. To the other modulator input is fed a signal from a timing oscillator which is either the same one as was used for recording or another which generates the same frequency (60 cps as we have assumed) within very close limits. The output from the modulator is a difference-frequency signal whose phase is proportional to the difference in frequency between the two input signals and thus indicates whether the tape is going slower or faster than when it was recorded.

It is easier, however, to consider that the balanced modulator puts out a d.c. signal whose polarity indicates the difference between record and playback speeds and whose amplitude is proportional to the actual speed difference. This d.c. is fed to a phase-sensitive solenoid whose plunger is rigidly connected to the lightweight playback head. The head is mounted on rails so that it can

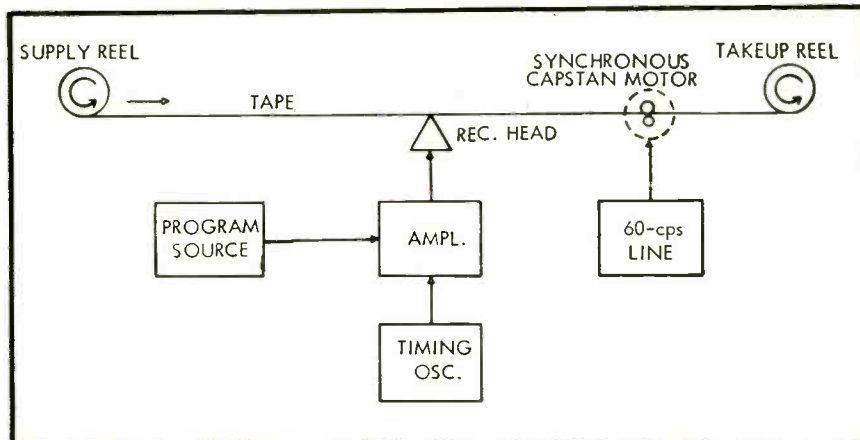
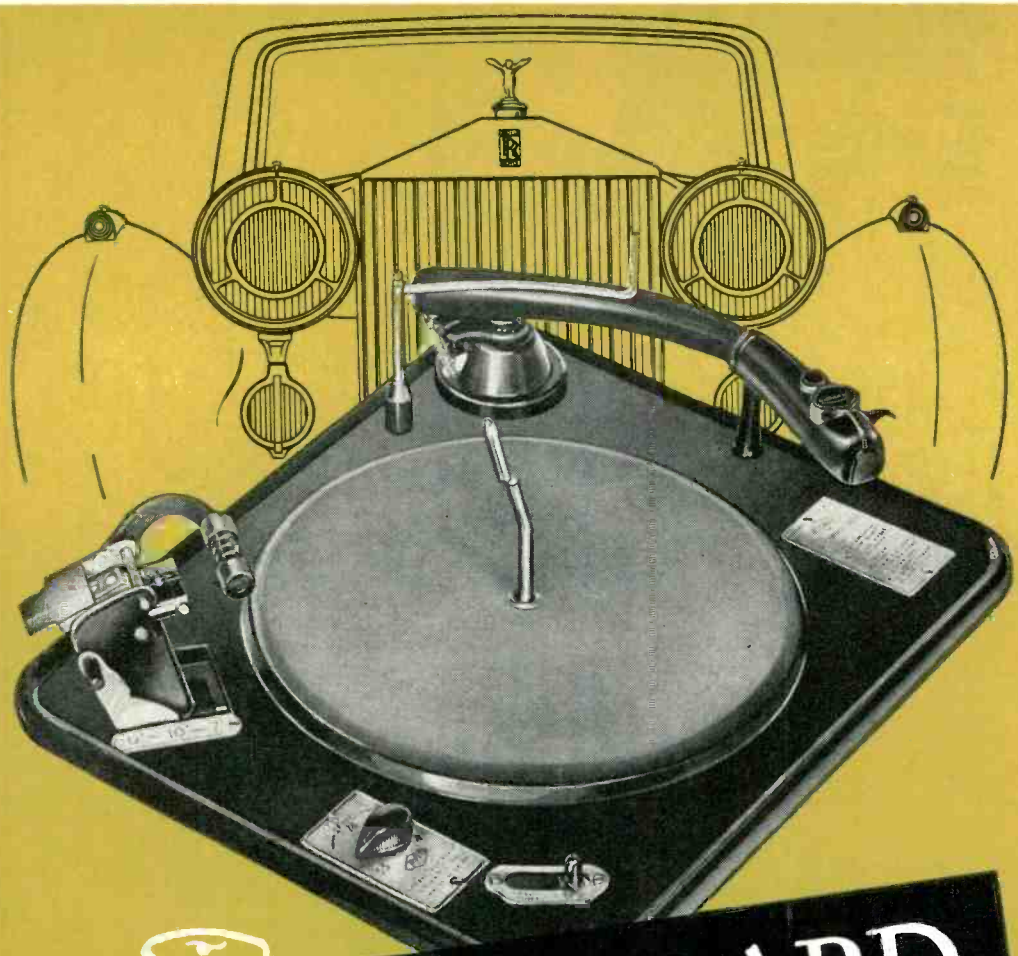


Fig. 1

Incomparable...

Since 1935
the Garrard has been
sold and serviced
throughout the United States.



**CHECK CRAFTSMANSHIP, FEATURES,
PRICE AND SERVICE . . .**
and you will understand clearly why this is
the world's No. 1 high-fidelity record changer

It is recognized every where
for superior
performance, ruggedness
and reliability.

"RIGHTS" and "WRONGS"
of record changer design
(important in protecting your records).

RIGHT:
Garrard Precision Pusher Platform . . .
the only record changing device that insures
positive, gentle handling of records with standard
center holes.



WRONG:
"Overhead Bridges" (as on ordinary changers)
. . . which may damage or dislodge records
accidentally.

RIGHT:
Garrard removable and interchangeable
spindles . . . Easily inserted; accommodate all
records, all sizes, as they were made to be
played; pull out instantly to facilitate removal
of records from turntable.



WRONG:
Fixed Spindles (as on ordinary changers) . . .
which require ripping records upwards over
metallic spindle projections after playing.

Other Garrard features include: 4 pole motor
—no rumble, no induced hum • heavy drive shaft
—no wows, no waves • weighted turntable—
flywheel action, constant speed • muting switch
—silence between records • silent automatic
stop—shuts off after last record; no disturbing
"plop". • easy stylus weight adjustment—pro-
tects long-playing records • balanced-mounted
tone arm—true tangent tracking • universal shell
—fits all popular high fidelity cartridges

GARRARD "Triumph"

World's Finest Record Changer

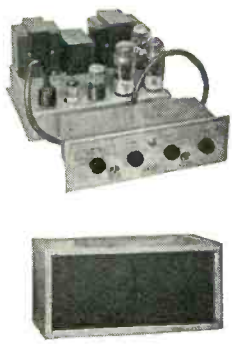
A Quality Endorsed Product of the BRITISH INDUSTRIES GROUP,
which also includes

WHARFEDALE LOUDSPEAKERS . . . designed and built under the personal supervision of G. A. Briggs . . . world renowned authority on sound. Wharfedale Loudspeakers offer the unique construction feature of cloth suspension—a felt buffer between speaker frame and cone—and cast chassis.

LEAK TL/10 —High fidelity AMPLIFIER complete with "Point One" REMOTE CONTROL PRE-AMPLIFIER. Most economical amplifier combination ever built by Leak. Harmonic distortion only one tenth of one percent. Insures flawless reproduction. **EXCLUSIVE FEATURE!** Convenient tape recorder jacks (input and output) on front panel for instantaneous use!

R-J LOUDSPEAKER ENCLOSURES—"Maximum Bass—Minimum Space" Hearing is believing! R-J Speaker Enclosures have established an entirely new trend in audio design with thrilling performance from any loudspeaker, Bookshelf and Floor Models.

THE R-J WHARFEDALE . . . First and only complete R-J unit! Two great products—the R-J single shelf ENCLOSURE and a special WHARFEDALE SPEAKER have been brilliantly matched in this . . . the definitive combination among compact high-performance speakers.



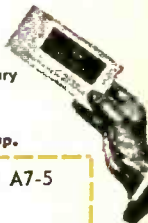
**WRITE FOR A COPY OF
"SOUND CRAFTSMANSHIP"**

Mail coupon today for a complimentary copy of "Sound Craftsmanship" 16 pages illustrating and describing all products of the British Industries Group.

BRITISH INDUSTRIES CORP., Dept. A7-5
164 Duane Street
New York 13, N. Y.

Please send "Sound Craftsmanship" to:

Name _____
Address _____
City _____ Zone _____ State _____



London Letter



RICHARD ARBIB^o

simplify custom FILTER installation

The 4200 Variable Filter and 4201 Program Equalizer are now available in component form, as illustrated, for the custom builder.

In addition to the flexibility of installation, all the features and characteristics of the standard models are retained.

The high and low sections of either model may be obtained separately. Complete wiring instructions included.

Send for Bulletin TB-4



Model 4200 Variable Filter
(Send for Bulletin S)



Model 4201, Program Equalizer
(Send for Bulletin E)

Representatives in
Principal Cities

HYCOR
Company, Inc.

Subsidiary of International Resistance Company
11423 VANOWEN STREET
NORTH HOLLYWOOD 3, CALIF.

IS THERE GOING to be a U.S.A. Audio invasion of England? Many readers may not realise that U.S.A.-made Audio products are not sold in the British Isles. Since the War when most of our Overseas investments had to be sold to pay for guns and tanks from America, no dollars have been available to pay for luxuries. The only American made products on sale in England are token quantities of those Companies who exported to England before the War and the amounts are so negligible that they are hardly noticed. To overcome these difficulties, some of the leading U.S.A. firms have, in the last few years, established factories in Britain so that they can sell American designed products in the United Kingdom and the Continent of Europe. Manufacturers of business machines, typewriters, and some electrical products are some of the organizations who have established factories in the British Isles, but U.S.A. Audio firms hitherto appear to have neglected the British market.

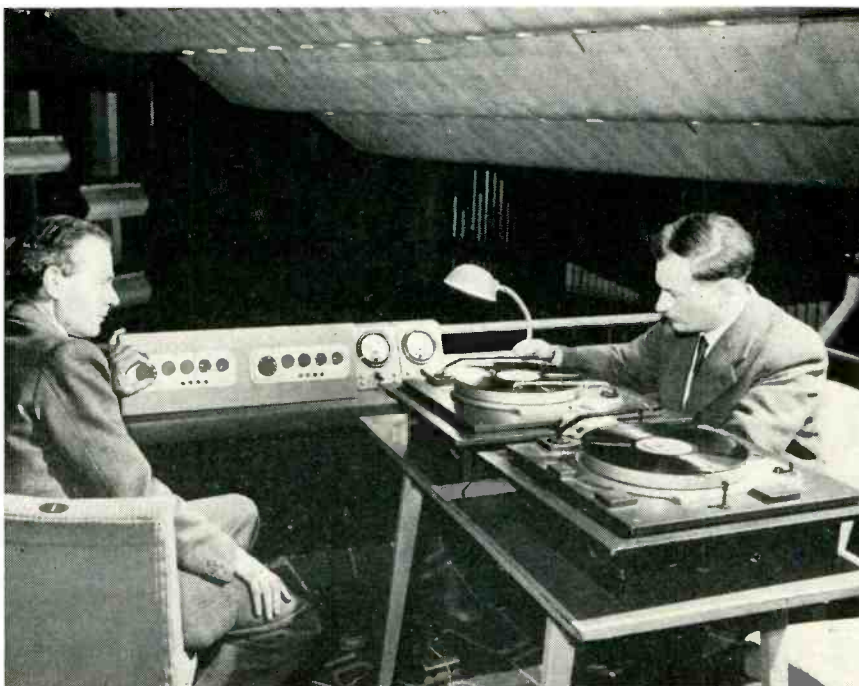
However, when the British Radio Show opens its doors at Earls Court, London, on August 24th, a name very well known in U.S.A. will, for the first time, have a booth

Multicore Solders, Ltd., Hemel Hempstead, Herts., England.

and demonstration room at the Show. It must be strange to U.S.A. readers to learn that R.C.A. is comparatively unknown in England. For some years now they have had a small Company which has been responsible for the servicing and maintenance of their sound equipment for the cinema industry. They are now planning to enter the British market and have acquired a factory near London, in order to manufacture a range of Audio lines.

New High-Quality Amplifier

The first will be a high-quality amplifier with a 12-watt output, somewhat similar in specification to those already made by Leak, Quad, and Pye. The preamplifier will be separate and will be available in two forms, one in a wood case and the other as a bare chassis for installation in a combination cabinet. There will be six control knobs with an ingenious arrangement whereby the knobs do not move across graduations on a scale, but these graduations appear behind illuminated windows on the panel. Other novel points in design will be that all the resistors and capacitors on the preamplifier will be on hinged panels which swing forward for easy servicing. H. T. (plate) and L. T. (filament) supplies



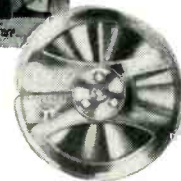
P. J. Walker (left) and John Collinson of Acoustical Manufacturing Co., (QUAD amplifiers) at the controls of the equipment used on the occasion of Mr. Briggs' second Festival Hall concert on the 21st of May.

Encore for a magnificent performance



12 NEW
Encore
Treasure Tapes

ONLY 59c EACH
AVAILABLE ONLY FROM
YOUR ENCORE DEALER



long playing,
authentic excerpts
from the actual
Master Tapes of
famous High Fidelity
Recordings



exclusively reproduced to introduce

Encore WIDE LATITUDE

A brilliant new innovation in recording perfection that insures flawless, professional tape reproductions with most recorders, regardless of the experience of operator or recording conditions.

Tapes

- Quality tape-recorded results
- Broad enough bias range
- Exceptional abrasion resistance
- Superior frequency response
- Top performance regardless of volume
- Performs well on any recorder
- Greater tensile strength
- Unaffected by storage conditions
- Consistent mechanical endurance
- New self-threading reel



LONG-PLAYING MYLAR
PROFESSIONAL ACETATE



SPECIAL MAIL OFFER: →

You pay only 59¢ for this Exclusive Encore Treasure Tape, "Excerpts from Dubbings Test Tape No. D-110" . . . THE MEASURE OF YOUR TAPE RECORDER'S PERFORMANCE. Tests for maximum and normal recording level, rough and fine head alignment, timing and tape speed, wow and flutter, signal-to-noise ratio. NOT for sale anywhere. Obtainable only by mailing this coupon.

Because of the anticipated demand, this offer is necessarily subject to cancellation or change without notice.

TECHNICAL TAPE CORP., Morris Hgts., New York 53, N. Y.

TECHNICAL TAPE CORP.

Dept. A-7

Morris Heights
New York 53, N. Y.

Gentlemen:

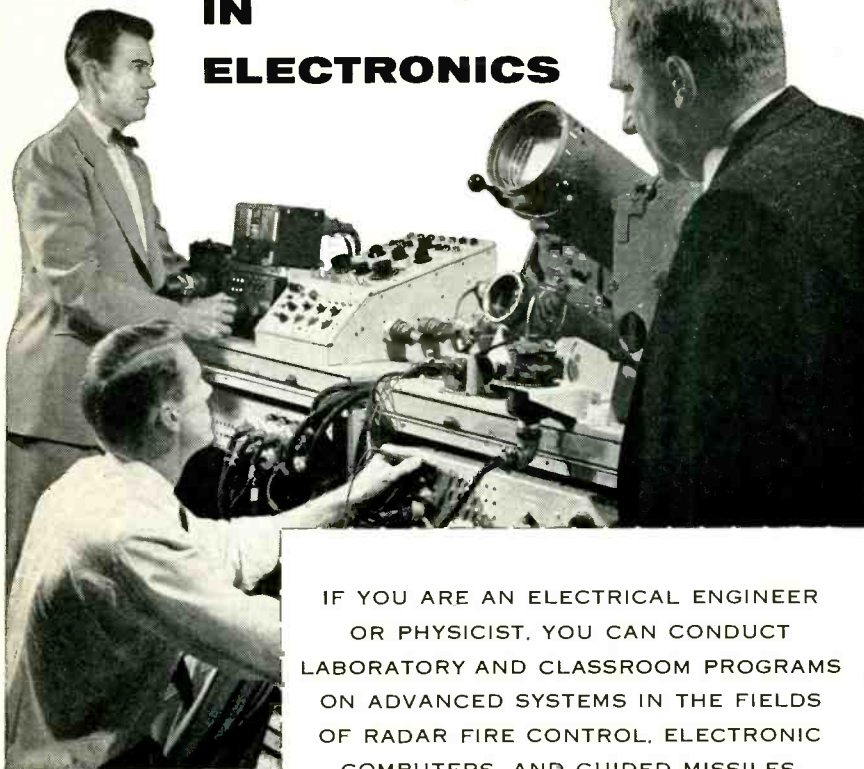
Please send me Treasure Tape "Excerpts from Dubbings Test Tape No. D-110". Enclosed is 59¢ plus 10¢ for postage and handling.

NAME: _____

ADDRESS: _____

CITY: _____ ZONE: _____ STATE: _____

HOW YOU CAN ADVANCE IN ELECTRONICS



Maintenance instruction on an advanced Hughes fire control system.

IF YOU ARE AN ELECTRICAL ENGINEER OR PHYSICIST, YOU CAN CONDUCT LABORATORY AND CLASSROOM PROGRAMS ON ADVANCED SYSTEMS IN THE FIELDS OF RADAR FIRE CONTROL, ELECTRONIC COMPUTERS, AND GUIDED MISSILES.

As a training engineer you will become familiar with the entire systems involved, including the most advanced electronic computers. With this advantage you will be ideally situated to broaden your experience and learning more quickly for future application to advanced electronics activity in either the military or the commercial field.

At Hughes Research and Development Laboratories in Southern California you, as an engineer assigned to this program, will be a member of the Technical Staff. Prior to instructing you will receive technical training to become familiar with the latest Hughes equipment.

THE TIME WAS NEVER MORE OPPORTUNE THAN NOW FOR BECOMING ASSOCIATED WITH THE FIELD OF ADVANCED ELECTRONICS. BECAUSE OF MILITARY EMPHASIS THIS IS THE MOST RAPIDLY GROWING AND PROMISING SPHERE OF ENDEAVOR FOR THE YOUNG ELECTRICAL ENGINEER OR PHYSICIST.

HUGHES

RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, California

SCIENTIFIC AND
ENGINEERING STAFF

will be available for feeding a tuner unit. There will be an adjustable output to match all loudspeaker impedances. The output valves used will be the well known KT66. These were some of the advance details which were given to me by Angus Walker who has joined R.C.A. in order to promote specially the sales of their Audio products.

At the Radio Show, R.C.A. will be offering for immediate delivery only the amplifier of which the U.K. price is likely to be \$132. This is nearly half as much again as the home price of the Leak TL/10 and preamplifier which is probably the biggest selling amplifier in this Country. As the R.C.A. amplifier will be even more expensive than the Quad and Pye models, it seems likely that Mr. Walker is going to have a difficult job to do. Incidentally, he is no relation to P. J. Walker of Acoustical Manufacturing Company, who make the Quad amplifiers.

Loudspeakers with Wharfedale Units

R.C.A. are also going to manufacture an FM/AM tuner and some loudspeaker units of which one type will embody a Wharfedale W12/CSAL. Another speaker to be used in the R.C.A. demonstration room at the Show will incorporate two 15-in. Wharfedales, coupled to a reflex horn, 12- and 8-in. Wharfedales, and an R.C.A. high-frequency pressure unit. Other plans that R.C.A. have in mind are the marketing of a tape deck and possibly a pick-up. By making these products in England, they hope to be able to sell them through the Companies that they established recently in France and Spain. Mr. Angus Walker was unable to give me any information regarding R.C.A. records which hitherto have been pressed in England by E.M.I. and sold under the H.M.V. label. Prior to the War, all R.C.A. records were handled by E.M.I. throughout Europe. In some countries these are now being made in local factories and marketed direct by R.C.A. in these countries.

A recent announcement in the radio trade press has revealed that the Webster-Chicago Corporation have formed a British Company, Webcor (Great Britain) Limited, who claim that before long they will be selling British made record reproducers, tape recorders and record changers.

As there is now virtually no unemployment in this Country, one difficulty which Overseas firms will have to overcome is that of obtaining sufficient and efficient labour. The restriction on the importation of foreign made Audio products does not extend to those manufactured in Europe but few lines reach the English market due to the efficiency of English manufacturers and to import duties.

Neat Tape Recorder

However, one foreign item which has recently won much favour in England is a very neat little tape recorder made by Philips in Holland. The Philips Company which is, of course, one of the largest organizations in Europe for the manufacture of radio and Audio equipment, has some of the largest radio factories in England. Nevertheless, they are importing from Holland this little tape machine which sells for \$103. It measures only 13 x 10 x 7 in. and thus it is easily portable. The price includes a crystal microphone, a 600 ft. reel of tape, and an empty reel. These can be left in position on the deck when the lid is closed. An additional reel can be carried in the lid which is detachable and incorporates ingenious methods of holding the mains lead, microphone and cable. The machine is dual track and operates at 3¾ ips. It has single knob control with

separate positions for recording from the microphone and radio.

It is one of the few tape recorders on the British market which operates off all voltages between 110 and 250. The built-in loudspeaker is of 5-in. diameter. Sockets are provided so that recordings can be made from a radio set or pick-up and the output can be extracted before the last stage for feeding to a high-quality amplifier.

This machine, in the opinion of your correspondent, represents the best value of tape recorders in Europe. Whilst it is not claimed that it gives the high-fidelity reproduction which is associated with a more elaborate machine such as the Ferrograph, it does, nevertheless, give reproduction when operated in conjunction with an external loudspeaker which is comparable with the average radio-gramophone combination available on the British market. By clever circuitry, only four valves are used and a special compensation network is incorporated which does much to make up for the loss of treble usually associated with 3¾ ips recording and reproduction.

Audio Fairs

Possibly, because Britain has an Annual Radio Show which is visited by more than a quarter of a million paying members of the British public, there are no Audio Fairs held in quite the same way as you have them in the United States. The nearest British event to an American Audio Fair is the annual exhibition of the British Sound Recording Association of which the 1955 Show recently took place at London's Waldorf Hotel. This is a much more modest affair than your American exhibitions of the same kind and had only 26 exhibitors. Nevertheless, it was a very live exhibition and some very interesting demonstrations were given in some of the private rooms of the hotel. Possibly the three most outstanding were those given by Leak, Acoustical Manufacturing, and H.M.V. The Acoustical Manufacturing and Leak demonstrations were really a battle of electrostatic loudspeakers. Harold Leak was demonstrating a prototype of his electrostatic/moving coil loudspeaker unit which, he hopes to have in production and on sale on the British market within three months. This comprises an electrostatic speaker for the treble and a special moving coil 15-in. speaker for the bass. The combined units together with crossover network but without cabinets, he hopes to sell in the home market for \$100. The demonstrations which were carried out throughout the days of the exhibition were really most convincing and many people expressed the opinion that this was the highest quality sound they had heard from what will be a commercial equipment. No additional amplifiers are necessary and the loudspeaker combination was operated from a standard Leak TL/10 amplifier. Visitors were also very much impressed by the Acoustical Manufacturing demonstration. Here, one electrostatic loudspeaker only is used and it is claimed that this covers effectively a range from 30 cps upwards. On the other hand, its development has obviously not progressed quite so far in regard to commercial production. P. J. Walker, Managing Director of Acoustical, told me that he did not expect to be in a position to fulfill orders for 2-3 years. The electrostatic speaker will be made in various sizes, but the one particularly recommended for the highest possible reproduction will be about 8 ft. high and is preferably built in to the wall of a room. Mr. Walker was unable to give me any idea of price, but technical readers of Audio who would like to have more information about both the

(Continued on page 26)



**unparalleled
performance**

Fairchild 220 Series diamond cartridge

Try this world-leading cartridge and hear the best reproduction your hi-fi system can offer!

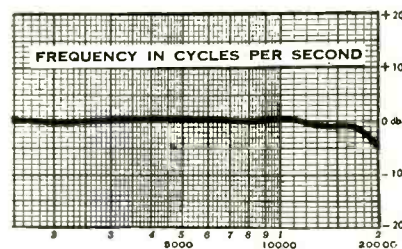
Moving-coil design, low-moving mass, are only two reasons why this new high-compliance Fairchild 220 can *guarantee* smooth,

uniform performance, eliminating harsh, unnatural sound in all ranges.

Just compare the amazing 220 with your present cartridge . . . and *hear* what you've been missing in sound perfection! **\$37.50**

Here's Proof!

Look at this even, undistorted response — completely uniform up to 17,000 cycles with slow roll-off beyond. That's your guarantee your records will be brought to life with the most satisfying, most dramatic sound.



POWER for the finest sound

20 years' Fairchild experience in production of professional recording equipment were necessary to produce this superb power amplifier for home use.

All the power you'll ever need is available — full 50 watts to accommodate crescendos and peaks that would overload an ordinary amplifier. And, Fairchild 260 is so stable that it is guaranteed not to ring at any level — even where two-way and three-way speaker systems are used!

FAIRCHILD
50-watt
professional
amplifier
\$149.50



**FAIRCHILD RECORDING
EQUIPMENT**

9th AVE & 154th ST., WHITESTONE, N. Y.

first in its power range
designed specifically for...

audio service



TUNG-SOL BEAM POWER AMPLIFIER

6550

- HIGH POWER CAPABILITIES (Up to 100 watts output in pairs)
- LOW DISTORTION OUTPUT
- EXTREMELY UNIFORM CHARACTERISTICS
- LONG LIFE

The Tung-Sol 6550 is a brand new and direct approach to the high power design requirements of high fidelity audio amplifiers. For outputs up to 100 watts, two 6550's in push-pull will provide the same power now attained in most existing designs by the use of four or more tubes.

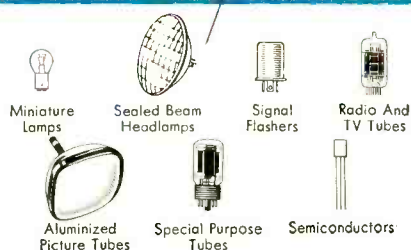
In addition to greater audio output, use of the new 6550 results in simplified electrical balance, reduced maintenance and lower cost. The Tung-Sol 6550 is not directly interchangeable with the 6L6, 5881 or KT66 class of tubes. With proper circuitry, however, the 6550 will provide full power output with approximately the same grid voltage drive as the other tubes.

The 6550 is produced under laboratory conditions with exhaustive quality control to assure premium performance and long life.

Write for technical data sheets.

TUNG-SOL ELECTRIC INC., Newark 4, N. J.
Sales Offices: Atlanta, Chicago, Culver City, Dallas, Denver, Detroit, Montreal (Canada), Newark, Seattle

TUNG-SOL® AUTOMOTIVE AND ELECTRONIC PRODUCTS



LETTERS

Damping Factor—A New Approach

SIR:

As the one originally responsible for introducing the term "damping factor,"¹ the writer feels some responsibility for finding an alternative form now that we are so deeply in the morass. The term had many shortcomings but it could, at least, be used safely so long as it was always finite and positive. The commercial release of amplifiers with negative damping factors has been very confusing to engineers, to say nothing of the general public. For an increase of 22 per cent in total circuit damping, the "damping factor" increases from 10 to infinity, then returns back from minus infinity to -10. All these extraordinary changes in the damping factor would lead one to believe that something important was happening. In reality, nothing has happened except a slight and steady increase in the total damping. The tricks played by the so-called damping factor are due merely to an unfortunate choice of definition. With this definition, instability occurs when the damping factor ≤ -1 .

The total circuit damping is a function of the total circuit resistance, which is the algebraic sum of the voice-coil resistance (always positive) and the amplifier output resistance (positive or negative). I therefore put forward the following as a much more satisfactory and logical substitute for damping factor:

$$\text{Damping Ratio} = \frac{R_L}{R_L + R_O}$$

Where R_L = load resistance, and

R_O = output resistance of amplifier,

and where both R_L and R_O are referred to the same side of the transformer.

The following table is for $R_L = 15$ ohms, as an example:

R_O (ohms)	$R_L + R_O$ (ohms)	Damping factor $= R_L / R_O$	Damping ratio $= R_L / (R_L + R_O)$
+ 75	+ 90	+ 0.2	0.167
+ 3	+ 18	+ 5	0.83
+ 1.5	+ 16.5	+ 10	0.91
+ 0.15	+ 15.15	+ 100	0.97
0	+ 15.0	∞	1.0
- 0.15	+ 14.85	- 100	1.01
- 1.5	+ 13.5	- 10	1.11
- 5.0	+ 10.0	- 3	1.5
- 12.0	+ 3.0	- 1.25	5.0
- 13.6	+ 1.4	- 1.1	10.7
- 14.3	+ 0.7	- 1.05	21.4
- 15.0*	0	- 1.0	∞

* on verge of instability

It will be seen that the proposed damping ratio is positive and finite so long as instability does not occur. It is also proportional to the actual damping in the circuit. It appears to be the only available function with all the desired qualities.

F. LANGFORD-SMITH,
Amalgamated Wireless Valve Co. Pty. Ltd.,
Sydney, Australia

Stylus Force

SIR:

In the PHONO EQUIPMENT section in the June issue, you seem to be championing the cause of the advocates of 6-gram standard stylus force.

Comparing the wear of tires on heavy automobiles *vs.* those on light automobiles was left as a valid argument for the cause of the 6-gram proponents. This seems to be upside-down logic.

You are comparing rolling friction with sliding friction when you compare automobile tires with phonograph pickup styli. A more appropriate analogy would be the wear produced by a sled on dry pavement. Everyone knows that the more load on the sled, the greater damage done to the runners and the pavement.

There is little point in drawing analogies, since we have proof that a pickup designed to track properly at one gram increases the life of the record and the stylus enormously over a pickup designed for six grams. This was demonstrated and documented at the last Audio Fair in New York.

PAUL WEATHERS, President,
Weathers Industries, Inc.
66 E. Gloucester Pike,
Barrington, N. J.

¹ F. Langford-Smith, "Radiotron Designer's Handbook," 3rd ed., 1940.

NEW LITERATURE

● **Chicago Standard Transformer Corporation**, Addison and Elston Avenues, Chicago 18, Ill., announces that its new 1955 catalog is a completely revised and expanded reference book, listing 543 Stancor transformers and related components. Illustrations of each transformer type appear on the same page as its listing, greatly facilitating selection of replacement units. The catalog has a comprehensive classified index and separate headings for each model to assist the user in locating the transformer he needs. Copy of Catalog S-101 may be obtained from Stancor distributors or by writing the factory direct. **L-12**

● **Electro-Voice, Inc.**, Buchanan, Mich., is now issuing a new condensed 14-page catalog which illustrates and describes the entire E-V line of audio components and accessories. A special section is devoted to microphones for TV, broadcast, and public-address application, as well as to a number of models for special purposes. Other sections cover high-fidelity speaker systems and matching enclosures, Circlotron amplifiers, public-address speaker systems, RME communications products, and replacement cartridges. Requests for copy should Specify Catalog No. 123. **L-13**

● **Hycor Company Inc.**, 11423 Vanowen St., North Hollywood, Calif., in newly-published Bulletin MA, describes the firm's standard-type magnetic amplifiers of toroidal construction, and supplies information regarding special designs to suit individual requirements. The bulletin is a single sheet punched for inclusion in loose-leaf files. **L-14**

● **The Stephens Manufacturing Corporation**, 8538 Warner Drive, Culver City, Calif., covers the entire line of Stephens Tru-Sonic speakers, enclosures, and accessories in a new catalog of unique design which will be mailed on request. This new piece of literature is made up of five separate loose-leaf sections placed in a file-size folder which has ends folded to form a retaining pocket. The first three sections are four pages each. They deal with speaker enclosures, coaxial and full-range speakers, and with complete speaker systems. The final two sections are two-page sheets concerned with component speakers, horns, networks, and theater installations. **L-15**

● **Cornell-Dubilier Electric Corporation**, South Plainfield, N. J., has prepared a comprehensive twist-prong-type capacitor cross-index and price list of recommended C-D replacements for four leading brands. More than 1000 different capacitor types are listed. Copies of the publication (Form UPX155) are available to the trade without charge. **L-16**

● **General Industrial Company**, 5737 N. Elston Ave., Chicago 30, Ill., is distributing a new catalog which should be included in the files of all purchasing personnel in firms which have need for material handling equipment, lockers, storage cabinets, safety ladders, steel trucks, and a multiplicity of other items used in industry. Also incorporated in the catalog are a number of laboratory items such as miniature automatic-control furnaces, wireless intercoms, precision program timers, and "See-Thru" storage cabinets with plastic drawers for storage of resistors, capacitors, and the like. Copy will be mailed on request. **L-17**

● **Triad Transformer Corporation**, 4055 Redwood Ave., Venice, Calif., has just released its new General Catalog TR-55 and Television Replacement Guide TV-155. Copies of both new catalogs are available from Triad jobbers or may be obtained by writing direct. Catalog TR-55 lists 685 items, 79 of which are new to the Triad line. Included among the new listings are: a series of sub-miniature audio transformers; several new high-fidelity output transformers; geofomers; and dry-disc rectifier transformers. Catalog TV-155 lists correct Triad replacement transformers for more than 5800 models of television receivers. **L-18**

**MAKE
YOUR
OWN**

**HIGH
FIDELITY
RECORDS**

with the **REK-O-KUT**

Challenger

**PORTABLE DISK RECORDER AND
PLAYBACK PHONOGRAPH**

The outstanding advantages of a disc recording is that it is permanent and it can be played back on any phonograph. Because of this, most tape recordings ultimately end up on discs.

If you would like to add your favorite tape recordings to your regular record library, it is a simple procedure to cut your own high quality record discs with a Rek-O-Kut Challenger. And you can also make direct recordings on disc—'live' or 'off-the-air'—at 33 $\frac{1}{3}$, 45 or 78 rpm. And when the discs are finished, you can play them back immediately on the Challenger or on your own high fidelity music system.

The Challenger is the only portable recorder that employs a professional overhead cutting lathe with interchangeable lead-screws, and a turntable driven by a hysteresis synchronous motor. The playback amplifier has a frequency response from 20 to 20,000 cycles \pm 1 db with independent bass and treble controls. A wide-range 10-inch speaker is mounted in the detachable cover. The playback arm is equipped with a dual sapphire magnetic pickup.



REK-O-KUT Challenger
for 33 $\frac{1}{3}$ and 78 rpm—with Standard
Groove Leadscrew \$459.95
45 rpm Accessory Idler 8.00

For complete description, write Dept. CG-1

REK-O-KUT COMPANY
MAKERS OF THE FAMOUS *Rondine* TURNTABLES
38-01 Queens Boulevard, Long Island City 1, N. Y.

EDITOR'S REPORT

THOSE WHO HAVE FOLLOWED the progress of hi-fi over the past five or six years are thoroughly agreed that it is possible to assemble a group of components into a complete system which will provide exceptionally fine reproduction of music in the home. In the last several months, we have noted a growing interest in the so-called "packaged" systems which consist of a number of components usually selected by the dealer or sound specialist and assembled or "packaged" into a complete cabinet—or two cabinets, where the loudspeaker is preferred as a separate unit—and sold as a unit. Obviously, presuming that the assembler's choice of components is good, this is no different than when the consumer buys the same parts and assembles them himself into a cabinet of his choice. As a matter of fact, when the assembly is made by the sound distributor or specialist, the chances are that the work will be done in a more workmanlike fashion, the control shafts will be properly centered in the holes in the panel, the wiring will be shipshape, and so on. But the important thing is that the individual components are each chosen for their own characteristics, and that no compromises are necessary—except possibly for budget limitations—in the choice of equipment. So as long as the "packaged systems" are composed of a number of high-quality components put together in this fashion, we are heartily in favor of them, for not everyone is handy with tools—or even has those that would be necessary—nor is everyone interested in doing the work himself. At least, this type of "packaged" system gives the advantages of a high-quality hi-fi home music system to those who might not otherwise be able to have them.

On the other hand, we have all heard of so-called "hi-fi" systems which are claimed to be at least as good as—or even better than—a properly assembled component system, with money-back guarantees of the claim. Of course, no one who knows his way around in audio believes the claims—not for a minute. However, if the claims are repeated with considerable frequency in places where the uninformed public may continue to see them, it is just possible that they might succeed in convincing the public.

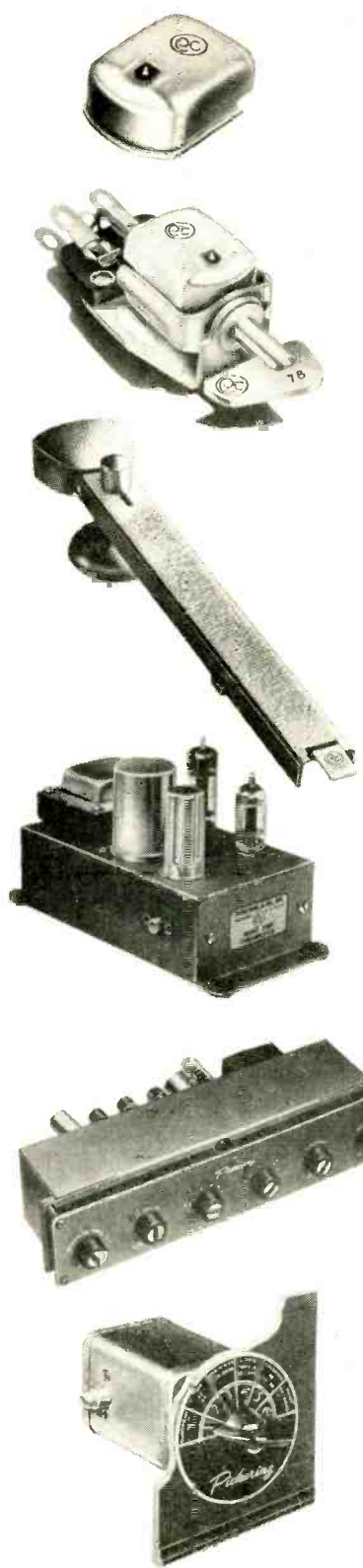
We haven't the slightest quarrel with the idea of

"packaged" systems—provided they *do* sound as good as the assembled component system. And there's the rub. None of them do. No one who takes the time to compare component systems *vs.* factory-packaged systems is likely to be fooled by the claims. But finding an opportunity to make direct comparisons may be difficult, for those who sell one type rarely sell the other. And the human ear does not have a sufficiently long retentivity for sound—unless it is especially trained—to make comparisons which are separated by an hour or so if the results of the comparisons are to be valid. One should always insist on an opportunity to make direct, side-by-side listening tests before making a decision. Then and only then can the judgement of the listener be relied upon.

We know, of course, that the manufacturers of audio components do not necessarily have a corner on all the good audio engineers in the country. But we believe that we are justified in saying that if the quality of the engineering personnel may be judged by the quality of the product that the manufacturing organization produces, it appears that there is some sort of corner on the market for audio engineers—and it seems to be with the component manufacturers.

We should not like to define a hi-fi system as one in which the loudspeaker is located in a separate cabinet from the rest of the equipment, for we have heard some excellent systems which were in a single cabinet. These have been exceptions, though, and we have also heard some pretty poor systems in a single cabinet. As a general rule, however, we do not favor a single cabinet for a home music system, and we do feel that it is a compromise when the loudspeaker must be placed in the same housing with the phono equipment. But we will say, without any equivocation whatever, that no assembly of equipment can rightfully be called "high fidelity" if the loudspeaker is housed in an open-backed compartment of a cabinet after the manner of early radio consoles. And on this point, we imagine that anyone in the audio industry will agree with us.

Comparisons are odious—according to an old saying—but not nearly as odious (odorous?) as some of the claims that have been fed to the public in the name of "hi-fi."



PICKERING

Pioneers in High Fidelity


... and leaders today!

Ask those who know—the experienced professionals and the veteran hi-fi owners—and you'll get answers like these:

"Pickering was first to introduce many high fidelity features that have become accepted standards today."

"Pickering has always been the pace-setter in the race for perfection."

"Pickering still sets the goals to which others aspire."

There are good reasons for such praise. Every product bearing the Pickering name is *precision engineered* to give optimum performance. Each individual component is rigidly tested before it reaches the dealer ... subjected to the severest quality control procedures to make sure that every  component comes up to the high standards expected of Pickering equipment.

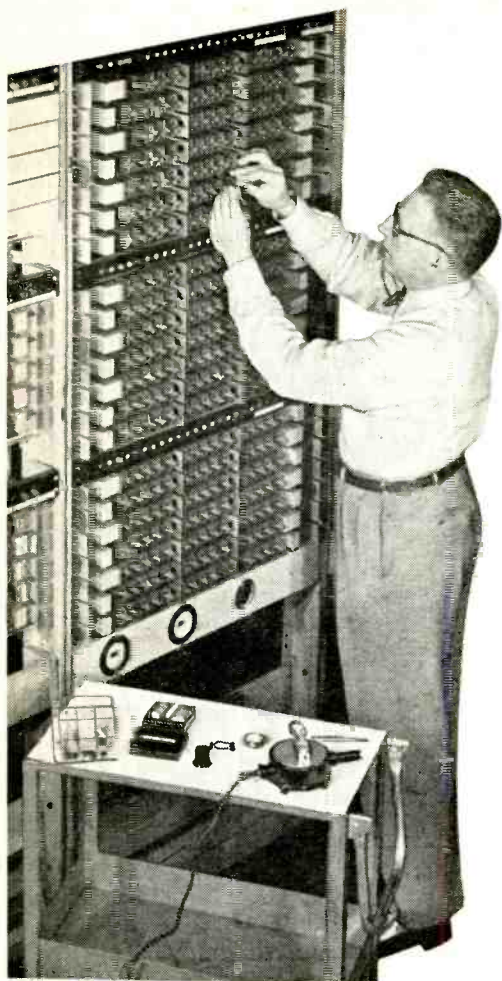
If you want the *best* that high fidelity can offer ... if you are willing to invest just a *little* more to get a *lot* more listening pleasure, now is the time to ask your dealer for a demonstration with Pickering components. See if you, too, don't *hear* the difference!

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

PICKERING PROFESSIONAL AUDIO COMPONENTS

"For those who can hear the difference"

... Demonstrated and sold by Leading Radio Parts Distributors everywhere. For the one nearest you and for detailed literature; write Dept. A-7



He's "fingerprinting" a relay contact

Bell Laboratories microchemists have perfected an ingenious new technique for "fingerprinting" relay contacts, the tiny switches on which a dial telephone system critically depends.

Using a portable test set, a chemist makes a plastic print of a contact. On-the-spot examination of the print with a microscope and chemical reagents quickly reveals the effects, if any, of arcing, friction, dust or corrosive vapors. While the chemist studies the print, urgently needed contacts continue in service. Findings point the way to improve relay performance.

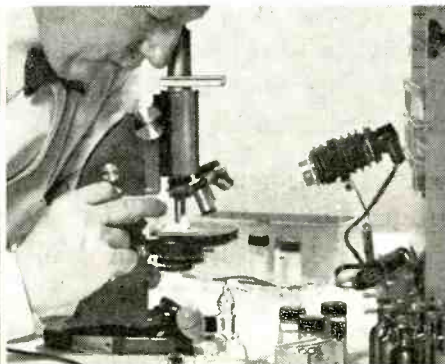
This is another example of how Bell Telephone Laboratories research helps to keep your telephone system the world's best.



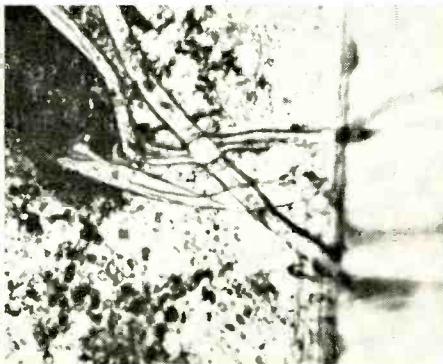
Above, Bell Laboratories microchemist applies plastic disc in heated clamp to relay contact. Imprint reveals contours of surface and picks up contaminants, if any. Part of portable test set is shown on table. Contacts, shown in small sketches, are of precious metal fused to base metal.



Preparing disc for microscopic examination. On-the-spot examination may reveal acid, alkali, sulfur, soot or other polluting agents peculiar to an area.



A microscopic look at disc often provides lead to nature of trouble. Unlike actual contact, print can be examined with transmitted light and high magnification.



Here the plastic disc has picked up microscopic lint that insulates contact, stops current. (Picture enlarged 200 times.) Traces of contaminants are identified in microgram quantities. Inert plastic resists test chemicals that would damage contact.



Bell Telephone Laboratories

*Improving telephone service for America provides careers
for creative men in scientific and technical fields*

An Output-Transformerless Amplifier-Speaker System

CURTISS R. SCHAFER*

This OTL amplifier requires no critical adjustments. It is used with a high-impedance speaker and a condenser tweeter.

AUDIO AMPLIFIERS without output transformers have been described in several papers within the past few years. As Fletcher and Cooke¹ and Onder² have pointed out, there are several good reasons for eliminating the output transformer. The amplitude, frequency, and phase distortions, as well as inherent copper and core losses, all make this transformer either expensive or undesirable.

Many of the output-transformerless amplifiers, however, have been unsuitable for the home music enthusiast because they either had insufficient power output (less than 10 watts), required a great many tubes in parallel, dissipated enough heat to warp the cabinetry, or permitted excessive direct current to flow through the voice coil (forcing it out of the gap or burning it up) if the output-tube cathode-current balance were not accurately maintained. This article describes the design and construction of an amplifier which (a) will feed a wide-range loudspeaker system directly (that is, without an output transformer), (b) has adequate power output (20 watts at 1.5 per cent intermodulation, using 40 and 8000 cps), (c) has a wide frequency range (within 1 db from 9 cps through 30 kc) at both high and low volume levels, (d) incorporates the new extended-range electrostatic tweeters, (e) is in accordance with the results of a great deal of fundamentally sound psychoacoustic research which has recently been published, and (f) is easy to assemble and wire. It is intended to be used as the main power amplifier, fed by a preamplifier or tuner with an output of 1 volt or so. A view of the complete amplifier appears in Fig. 1, while the two-element speaker system is shown in Fig. 2.

The schematic wiring diagram is Fig. 3. The power transformer has been retained for three important reasons: (a) a high plate-voltage supply at low current is required to enable the 5687 stage to furnish adequate signal voltage to the

following grids; (b) an electrostatic shield is desirable to reduce noise and hum from the power line; and (c) the regulating action of a filament transformer greatly reduces the initial rush of current into the heaters when the amplifier is turned on, and this action prolongs tube life. (In military and naval electronic equipment, the operation of heaters or filaments in series is forbidden because it results in short and erratic tube life.)

The amplifier input is across a 1-megohm volume control, which may be used as a pre-set. The input stage is followed by a conventional phase splitter. This phase splitter is self-balancing, has low distortion, and has an input impedance of about 10 megohms. These first two stages use a ruggedized tube, the GL-5814A, which is similar to the 12AU7 but has a very low heater-to-cathode leakage, which is important in a phase splitter of this type. A direct current supply is used on the heater of this tube to eliminate hum.

The 5687 is also a rugged, military-type tube which is capable of being operated at relatively high plate voltages without electrolysis of the glass at the base.

The 6337, which was developed in the spring of 1954 by Chatham Electronics Division of the Gera Corp., is the tube that has made this amplifier possible. With a transconductance of 45,000 μ mhos, plate dissipation of 80 watts, plate resistance of only 60 ohms, and a hard glass envelope, it is an audio output tube with exceptional power-handling capabilities, rugged internal construction, and a very long life. In conventional transformer-coupled circuits³ it is capable of delivering 7 watts at 3 per cent 1M (for one pair of tubes in class-A operation). In this circuit it is operated at only 60 per cent of its maximum plate dissipation, and one-third of the output

³ Curtiss R. Schafer, "30-watt high-fidelity audio amplifier," *AUDIO ENGINEERING*, July 1948, pp. 21-23.

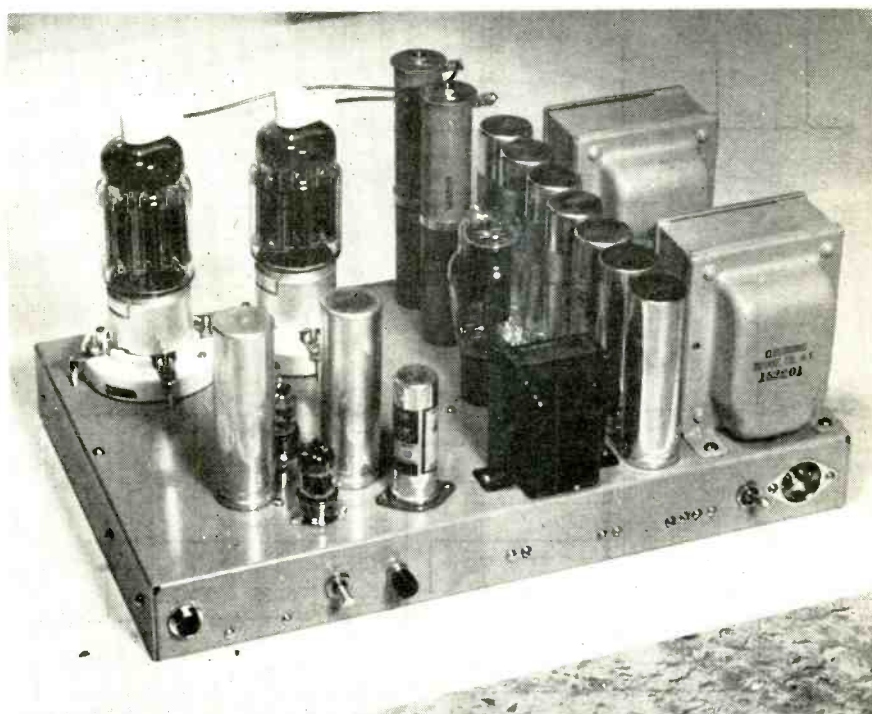


Fig. 1. The complete amplifier, with power supply, is on an aluminum chassis measuring 11 x 17 x 2 inches.

* Daystrom Instrument, Archbald, Pa.

¹ E. W. Fletcher and S. F. Cooke, "Cathode-follower loudspeaker coupling," *Electronics*, Nov. 1951, pp. 118-121.

² Kerian Onder, "Audio amplifier matches voice-coil impedance," *Electronics*, Feb. 1954, pp. 176-179.

power is dissipated in the plate-feed resistors, so the useable power output is about 20 watts. The plate-feed resistors R_{18} and R_{19} stabilize the load impedance at 167 ohms, despite the increase in impedance at the higher frequencies which characterizes moving-coil loudspeakers.⁴

The power transformer T_1 is available as type 1570461 from Electronic Transformer Co. It may also be duplicated by combining other power transformers which the constructor may have on hand. The current ratings of the various windings are as follows: 6.3 volt (Y), 1 amp.; 6.3 volt (Z), 14.5 amp., c.t.; 10 volt, 0.4 amp.; 5 volt, 2 amp.; 1000 volt, c.t., 40 ma.

The output of the 10-volt winding is rectified in a full-wave bridge rectifier and filtered for the heater of the 5814A. The value of the 15-ohm series resistance R_{28} should be set so that the voltage at the heater terminals of the GL-5814A is 6.0 volts at a power-line voltage of 117.

The low-voltage, high-current plate supply for the output stage uses four 1N158 fused-junction germanium rectifiers in a paralleled half-wave voltage-

doubler circuit, providing 250 volts at 800 ma. The 1N158 is a very efficient rectifier, having a drop of only 1.4 volts at full load. The 250 μ f capacitors are each made up of two 125 μ f units in parallel. A filter choke is used to ensure adequate filtering. (This power supply, incidentally, is almost exactly what is required for the operation of an output

stage using two power transistors, such as the Minneapolis-Honeywell type 2N57, as these transistors draw collector currents up to 700 ma each; the only difference is that a regular half-wave rectifier circuit may be used instead of a voltage doubler.) It is a common fallacy to assume that push-pull stages require less filtering in the plate supply. It is true that hum is cancelled out in a well balanced push-pull stage under zero-signal, quiescent conditions; however, the stage is unbalanced the instant a signal comes through, and the hum frequencies react with a signal frequencies to increase the over-all intermodulation distortion, especially at low volume levels.

It should be noticed that one side of the 117-volt power line is grounded in the amplifier. For this reason, a polarized receptacle should be installed where the amplifier will be used, and the cord conducting power to the unit should be fitted with a polarized plug. One side of the 117-volt line is grounded at the distribution transformer, and also where the line goes through the entrance switch; this side of the line will show no voltage, or only a few volts, when an a.c. voltmeter is connected between it and a good ground. This side of the line

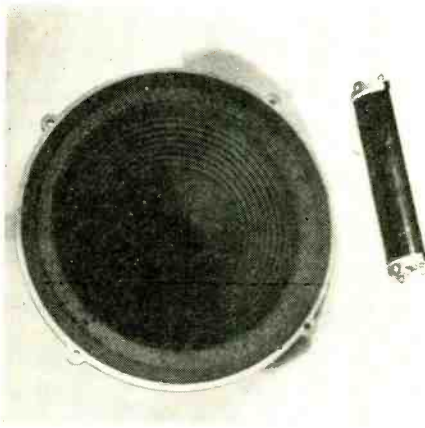


Fig. 2. The speaker, obtained from the maker on special order, and the Philco tweeter.

⁴ Edgar M. Villchur, "Handbook of sound reproduction: Loudspeakers," AUDIO ENGINEERING, March 1953, pp. 32-34.

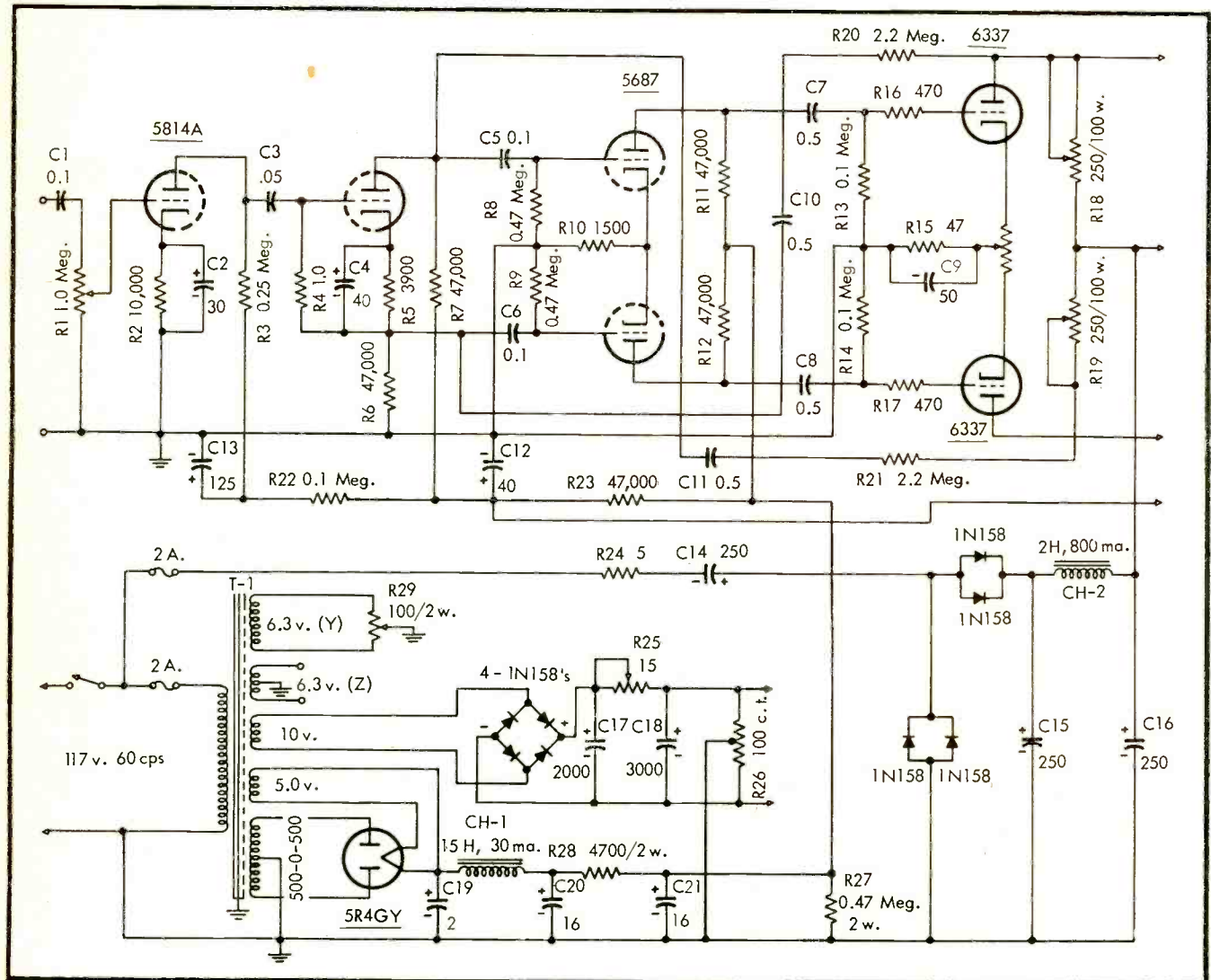


Fig. 3. Complete schematic diagram of the amplifier and power supply. Key to the new amplifier is the 6337 tube with its low plate resistance.

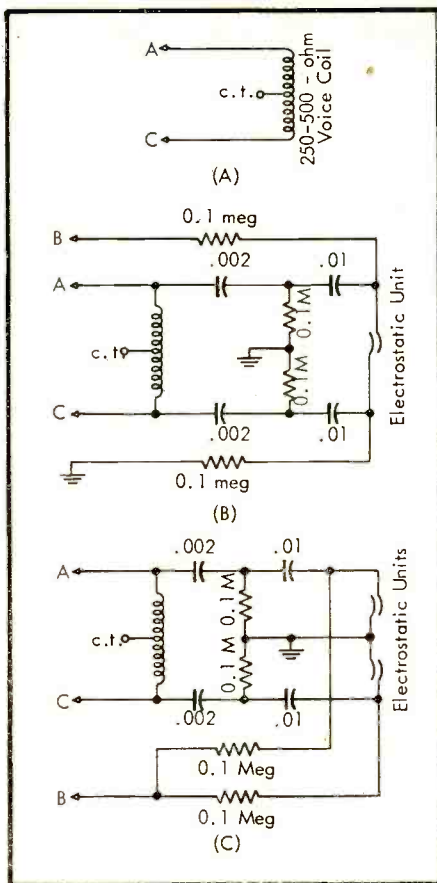


Fig. 4. Three methods of connecting speakers to the amplifier. At (A) a single high-impedance speaker; at (B) a woofer and electrostatic speaker; at (C) a woofer and two tweeters.

should be the same as the side that is internally grounded in the amplifier, and in addition, a heavy lead should be run from the binding post on the chassis to a good water pipe or radiator ground.

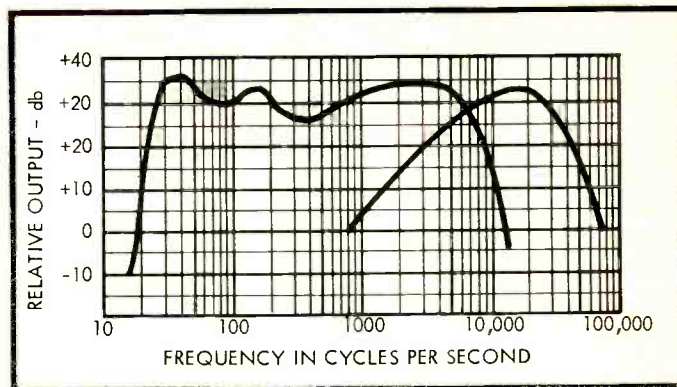
The power transformer and both chokes are mounted with their laminations perpendicular to the chassis; this results in the least amount of magnetic flux being radiated into the chassis. All ground returns must be made to a single point; the arrangement preferred here is a group of six solder lugs fanned out under the nut and split lockwasher of one of the screws holding the 15-henry choke. The use of an aluminum chassis also results in less hum from magnetic flux conduction. The chassis should be finished by being etched, anodized, and then having a coat of enamel baked on at about 35 deg. F. for 3 hours.

Negative Feedback

A great deal of negative feedback is not worthwhile in an audio amplifier. In the first place, practically no increase in speaker damping is achieved when the output impedance of the amplifier is made less than about one-third the impedance of the speaker.⁵ This is because the electrical and mechanical impedances of the speaker become the controlling factors.

⁵ Figs. 12-14 (damping effect of amplifier source impedance on speaker), *AUDIO ENGINEERING*, August 1953, p. 27.

Fig. 5. Over-all system response from each of the speakers when one woofer and one tweeter are used.



In the second place, many professionally designed amplifiers are regenerative at the low and high ends of their frequency ranges. Low-frequency regeneration is obnoxious because it causes the amplifier to overload with the rumble from a turntable. High frequency regeneration is undesirable because it gives a tinny or "hashy" quality to the highs; this tinny quality is often blamed on the metallic diaphragms used in most tweeters. High-frequency regeneration, as well as low, is caused by phase shifts in the coupling networks in an amplifier, so that the feedback is actually regenerative rather than degenerative, and it has been very much in evidence in a great many recent amplifier designs, as shown by the little ripples which ride the top of a square wave passed through these amplifiers.

In the present amplifier, about 2 per cent of the voltage on each output plate is fed back degeneratively to the input of the preceding stage. This is sufficient to stabilize gain and give some reduction in output impedance, and because the feedback is over only two stages, there is no evidence of either high or low-frequency regeneration.

All resistors are 1-watt unless other wattages are specified. The 270 ohm resistors R_{18} and R_{19} are required in this circuit because a high-resistance voice coil cannot carry the plate currents for the output tubes. Isolating capacitors are not necessary however, because no direct current can flow through the voice coil even if the plate currents are badly unbalanced. Direct current will flow through the voice coil, however, if the coil is shorted to either the inner or outer pole-piece. For this reason, do not attempt to use a speaker with a rubbing voice coil. If the coil is properly centered, the usual insulation is adequate for the low plate voltage used.

R_{18} and R_{19} should be adjusted by means of the sliding taps so that their resistances are approximately equal, that is, within 2 or 3 per cent of each other. This is easily done with an ordinary ohmmeter, not by reading the absolute values of resistance, but by seeing that the deflection of the meter is the same for both resistors.

No critical adjustments of any kind are required on this amplifier. Plate-current balance in the output stage need be only an approximation, for good low-frequency response does not depend upon

balancing out the direct current component in the primary of an output transformer. Balance within 10 per cent may easily be achieved by connecting a d.c. voltmeter between amplifier output terminal B and the voice coil centertap, and then adjusting R_{20} for a minimum reading on the voltmeter, reducing the voltage range of the meter as the unbalance voltage drops. If a speaker is used that does not have a tapped voice coil, adequate balance may be realized by adjusting R_{20} so that the voltage drop across R_{18} is equal to the voltage drop across R_{19} . Once the adjustment of R_{20} is made it may be forgotten for a year or two, as plate-current drift in the 6337 is negligible.

Loudspeakers

Any one of three speaker arrangements may be used. These are shown in Fig. 4. The one in (A) employs a 12-inch model with a centertapped 250-ohm copper voice coil, made up through the courtesy of the manufacturer. At this time, it is not considered it feasible to "make a speaker with an aluminum voice coil having an impedance of 250 ohms. The trouble is that aluminum wire is very fragile, and it is extremely difficult to tin, even by ultrasonic means, as the wire simply disappears during the process of tinning if it is too fine. It is also not possible to obtain aluminum wire in a very fine gauge because it is too fragile to handle." The speaker is simply connected across the amplifier output, plate-to-plate; a wire should be run from the frame of the speaker to the ground binding post on the amplifier chassis.

The frequency response curve of this speaker shows that with the copper voice coil it is deficient at the high frequencies (Fig. 5). One way of compensating for this deficiency is to use about 30 db treble boost in the preamplifier taking care to see that the treble boost complements the treble droop in the speaker so that a fairly flat response is obtained from the combination. The unit should be used in an enclosure that will provide adequate loading at the rear of the cone by means of a folded exponential horn.⁶

The best combination, however, uses
(Continued on page 42)

⁶ H. F. Olson and R. A. Hackley, "Combination Horn and Direct Radiator Loud-Speaker," *Proc. I.R.E.* Dec. 1936, pp. 1557-1566.

Experiences In Stereophony

PAUL W. KLIPSCH*

Cutting through the nettings of rumor and superstition which surround both merits and techniques of stereophonic tape recording, authoritative Mr. Klipsch gives hard facts, believable impressions of art.

AT THE PARTS SHOWS and audio fairs, several demonstrations advertised as "stereophonic" turned out to be two screeching speakers. Told to stand in the middle and toe a certain line with ears 5 ft. 4½ in. above a certain datum, the listener in complying still hears two screeching speakers. One 3-channel demonstration showed plenty of "separation," but gave the impression of three tiny ports in a thick wall. This demonstration used three non-corner speakers in space remote from walls. The same tape heard more recently over three corner speakers in L arrangement gave a better impression.

As a follower of the early art¹ and of stereophony and having talked with the envied few who heard the 1933 show, this writer felt there must be some merit to the art, and a potential of witnessing the effect without parting one's hair in the middle. Stereophony up to 1952 is reviewed by Tinkham² who also discusses speakers vs earphones, microphone type, microphone spacing, and other factors. This treatment had been lightly dismissed at first, but success can not be denied to have come about at least in part by way of this article with its suggestion of wide microphone spacing. After three years there is some disagreement in detail or choice of pressure versus velocity microphones; yet it can hardly be said to diminish the value of either the early or subsequent work.

Recording Equipment

Having an extra Concertone 1502 to play with, we bought an additional am-

plifier, together with a set of stacked stereo record and playback heads. The two amplifiers were mounted in a separate case. The two bias oscillators were synchronized by the simple expedient of connecting the two erase oscillator outputs to the same erase head. Fear of burning up the head was dispelled when Berlant-Concertone promised a new one if one burned out. Since then a Berlant stereo recorder was obtained; neither machine has given any erase-head trouble. Single-channel recording experience with several microphone types resulted in the choice of the Stephens C-2 microphone with the OD-4 oscillator-discriminator. The output transformer was bypassed. When the recorder was expanded to stereophonic the family jewels were pawned for a second microphone of the same type. The response of these microphones appears to be flat from less than 10 cps up to about 15 kc with an estimated 4-db dip at 16 kc and response beyond that diminishing in a series of wide peaks and narrow dips. Response could be detected out to 37 kc.

Procedure

The first consideration in a successful recording is to get "separation." This seemed to dictate a microphone spacing comparable to the speaker spacing. The first recording attempt was a table tennis game in the plant recreation room at coffee-break time. (Coffee breaks pay off in the most surprising ways.)

The first thing noted was that speakers located in corners against the long wall were better placed than when against the short wall of an oblong room. Thus in Fig. 1 only about a third of the room area is "stereophonic;" outside the "permissible" area either one speaker predominates or they blend with reverberation to conceal the stereo effect. But in Fig. 2, over half the room area becomes stereophonic.

In our case the room is about 30 feet wide, and we found the tennis table to be exaggeratedly long. It seemed, however, that this exaggeration was more tolerable than the absence of the effect. The same thing seems to apply visually on the wide movie screen where we are accustomed to seeing human heads as big as water tanks.

Fear of "lack of separation" prompted the first attempt at music recording to be of an organ and small brass choir. This permits not only wide microphone separation but also intimacy of each microphone with its subject matter. The result is almost spectacular, yet natural. The sensation is that of the pipe organ in one loft and the choir in another—a

sort of antiphonal effect. The speaker spacing in Fig. 2 is preferable. (Incidentally, since Fig. 2 is the speaker spacing considered tolerable in all cases, this remark will not again be repeated.)

A 7-piece dance band in a studio about 25×40 ft. was recorded with microphones 15 feet apart. The playback in the same studio was so exciting the band chimed in to form a duet with itself!

Longitudinal Stereophonic

The nearest approach to true stereophonic effect in a two-channel system would be obtained with what may be called *lateral stereophonic*, or placement

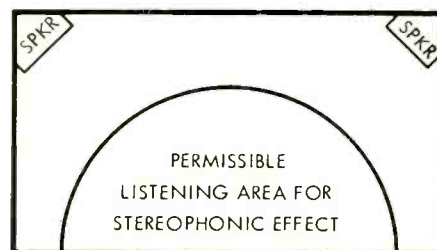


Fig. 2. The permissible listening area for corner speaker placement on the long wall is more than half the total room area. Contrast this with Fig. 1.

of microphones on a line perpendicular to the listening axis. Another very interesting application might be called *longitudinal stereophonic*. The deep-throated Robert Morton organ at Texarkana's Paramount Theater is in a single pipe loft. A lateral stereophonic did not appear *a priori* to offer much novelty. Accordingly, one microphone was placed about 20 ft. in front of the swell shades, the other about 80 ft. beyond that, up in the balcony. Gains were adjusted to give each volume indicator about the same peak reading.

The *a posteriori* results were gratifying. Previous monaural recordings of this organ had been judged "full range," and "just like the original organ," and these tapes were used to demonstrate the full-range performance of the speaker system being advertised on our tours. But the new stereo tapes are beyond words to describe. Attempts to describe by "just like adding color to a picture," or "adding a new dimension" are at best pictorial. It is fair to say it adds another level of approach to realism.

In conventional recording, an organ and 48-voice choir were recorded with microphones 15 ft. in front of the front row of singers, approximately 25 to 30

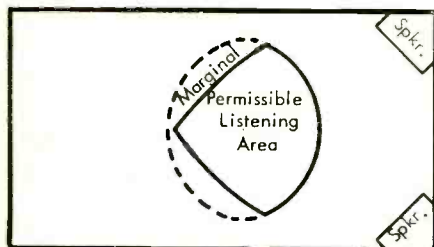


Fig. 1. Permissible listening area denotes the area where satisfactory stereophonic listening occurs with speakers in natural corners on the short wall of a room of 2:3 width to length ratio. The area is less than one-fourth the area of the room.

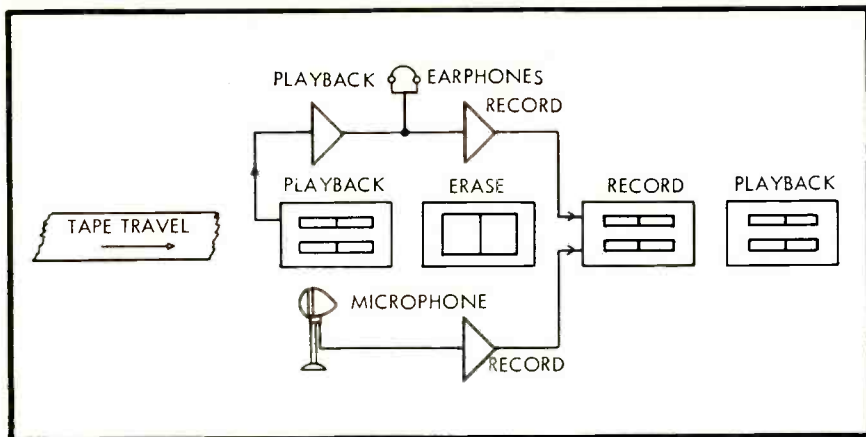


Fig. 3. Head, amplifier, earphone, and microphone circuitry for "poor man's binaural" or chronolateral stereophonic recording. Assume the first track has been recorded on top. The second track is recorded on the bottom while re-recording the top to get it stacked with respect to the second track.

it, in front of the back row, and about 35 ft. apart. It was feared the soloists in the middle would be too far away. The results were far more natural than those resulting from microphones near the soloists and subjected to a mixer in the hands of an engineer. The choral group is as effectively "spaced" as in real life, and the soloists are in natural loudness and geometry as they would be heard in the auditorium. Cutting either channel, by the way, drops the soloist somewhat into the background.

A full orchestra was recorded from the spotlight catwalk, where lack of preparation forced microphone placement at 22 ft. apart, more than 15 ft. in front of and about 15 ft. above the podium. *A priori*, a wider separation would have been preferred. *A posteriori*, the separation was adequate but a closer proximity would appear to me desirable. All faults notwithstanding (including a duet between soloist and a ventilating louver undergoing emergency repair) the recording has been judged superior to any single-channel recording.

Single-Microphone Stereophonic

An interesting potential is presented in what I choose to call the "poor man's binaural" because it takes only one microphone. The performer, say a pianist, plays one part of a duet, then dons earphones and tries to keep in synchronism while he plays the second part. The recordings are separate; the first piano reproduces through one speaker, the other piano through the other. As contrasted with lateral or longitudinal stereo, this might be called *chronolateral*³ stereo recording. Some neat tricks are involved to keep the two recordings in step on the now standard stacked heads, also to help the performer to keep together with the little man that wasn't there. Harlan Thompson of Berlant-Concertone⁴ suggested a stacked-head technique involving a playback head preceding erase, a variation of their

"sound-on-sound" device and method. For the interested, this is sketched in Fig. 3. Assume the first part of the recording to have already been performed on the top channel of the tape. This is played back and listened to by the performer, who plays the second part on the bottom channel of the tape. To get the two parts properly stacked, the first recording is erased and re-recorded simultaneously with the second recording.

This entertaining recording may or may not become a new and/or important art form. At present it is just a gimmick, but one which is revealing in the matter of musical structure and timing, and the individuality of performers. It is a lot of fun—and hard work for both performer and recordist.

Other Apparatus

It has been said that stereophonic with ordinary equipment has some advantages over single-channel reproduction with fine equipment. This is probably true to some degree, although stereophonic recording of a single solo instrument is marginal, and full range is always to be appreciated. One thing stands out clearly however. One does not need the full bass range on both sides. Naturally, my own personal preference is for a couple of Klipschorns, but one Klipschorn and a second speaker of lesser caliber is highly satisfactory. For a second speaker this writer has used 3-way (and even coaxial) drives in corner horns ranging from the Cabinart Rebel V up to the Rebel III and Shorthorn 36. The lack of ear directivity for the bass range denies any lack of bass on the "small channel. But a good trick to follow is to remember to record the "big" instruments on the same side of the tape, and play this side back on the "big" speaker. I designate the top channel as red, the bottom as "green," and when recording a variety of instruments, try to keep the bass on the bottom. It might be suggested as a standard to maintain the bass on the bottom.

Phasing Speakers

Much controversy about phasing of speakers clutters the literature. In 1940,

experimenting with a woofer-tweeter combination, it was reasoned that if one could phase the two to be spacially correct, then a 180-deg. phase shift of either should make it wrong. A toggle switch became a confusion switch. This experiment has been repeated on many occasions over the years, including application to a certain coaxial which is "phased to 1/4 inch." Always the same result. The phasing at some single point in space may be critical but we have two ears. There has never been a case wherein the phase reversal could be detected by ear. This is true of the stereophonic case.

This does not conflict with the "binaural" submarine detection methods used in World War I, wherein a rotary "slide trombone" varied the phase of received sound. The phase here was varied over a large number of milliseconds delay. The conditions are sufficiently different to be recognized. The simple fact is that speakers need not be phased,⁵ nor even be of the same type, and the same is true of the microphones. A copy in my library was made of a tape described as having been recorded with one velocity microphone and one condenser. The only criticism was that of frequency response; the side recorded with the condenser had the "steamy" quality associated with some types of condensers, and the ribbon was a little dull.

Commenting Upon Previous Work

Tinkham² states the microphones must be "placed as far apart as the speakers." It may be that the reproduction will be in a small room with closely spaced speakers; "should we, therefore, reduce the spacing of the mikes? Experiment says no." With this, recent experience is in agreement. Again Tinkham says, "placing speakers in the corners . . . does not appear to work as well as spacing them in a little way from the corner . . . a more normal sidewall reflection is set up. . . ." With this basic fact, elementary reasoning, and recent experi-

(Continued on page 41)

⁵ There are cases where speakers need to be phased. This is not one of them. One case is where two speakers covering the same frequency range are in close or fairly close proximity. Reversed phasing produces a meridian null which can be well defined.

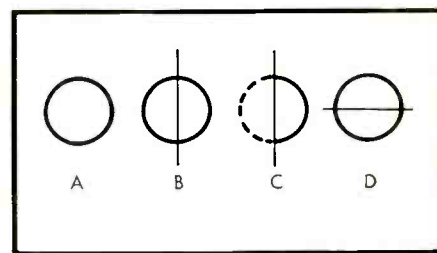


Fig. 4. Philosophy of the corner speaker. (A) symbolizes a non-directional radiator; (B) shows this bisected; (C) shows half the speaker of (A) with the other half a mirror image formed by a wall located at the bisecting line in (B); (D) shows bisection and a corner speaker producing the same radiation pattern in its quadrant as did the nondirectional speaker in the same quadrant.

³ Chronolateral: recording spaced in time, playback spaced in geometry.
⁴ Personal communication.

Commercial Acoustic Suspension Speaker

EDGAR M. VILLCHUR*

Performance data on the new loudspeaker system in which cone suspension is a carefully controlled volume of air.

IN THE OCTOBER 1954 ISSUE of AUDIO the writer described an experimental speaker system¹ in which the bulk of elastic restoring force was supplied by the pneumatic spring of the enclosures' air rather than by the cone's mechanical suspensions. The speaker mechanism itself had a subsonic resonant frequency, but when mounted in its acoustically sealed, Fiberglas-filled enclosure the final resonant frequency of the system was raised to a predetermined value of about 45 cps.

The present article is a report on a commercial unit built to the above design. It is considered that there is general interest in performance measurements of a device constructed on a new principle; in addition quantitative data on loudspeaker performance under carefully defined test conditions is relatively rare, and it is hoped that such a report may stimulate the publication of similar reports on other speakers.

The commercial unit is made as a two-way system, using a 12-inch acoustic suspension woofer in combination with a conventional cone-type high-frequency speaker, and is also made as a woofer system for use with other high-frequency units. The system is illustrated in Fig. 1. It was decided to report on the model with the woofer alone for the following reasons: (1) The point of the article is to make a quantitative report on the capabilities of the acoustic suspension system, and (2) test procedures are simplified and made more reliable, thus better subject to accurate duplication by others. Variables such as radiation angle, microphone calibration at higher frequencies, and interference effects between the two speakers which may make microphone positioning critical, are largely eliminated. The performance of the high-frequency section will be only briefly summarized.

The two basic criteria of measurement techniques are validity and reliability. Validity refers to the degree to which the tests measure what they are supposed to measure, and are uninfluenced by other factors. Reliability refers to the accuracy of the measurements: it is an index of the extent to which the meas-

urements can be duplicated at other times and places.

Reliability

A valuable paper on loudspeaker frequency response measurements² has pointed out the dangers involved in interpreting speaker frequency response curves when the exact test conditions are not known. Three such curves, made by three different acoustic laboratories using the identical speaker, were compared with each other and shown to differ by as much as 10 db at different portions of the frequency spectrum.

In the present case it was decided that unless test conditions could be established that would make it possible for results to be readily duplicated by anyone with the necessary facilities and skill, the measured data, while it might have a limited usefulness, would be unsuitable for publication. The frequency response and distortion measurements published here have been duplicated without significant variation. It is believed that any tests conducted under the same controlled conditions will achieve results which are within 1 db of the frequency response curve and will add or subtract less than one per cent to the values of the distortion curve.

Conditions Of Test

The enclosure was placed in a hole in the middle of a 2-acre field, its face

² Jensen Mfg. Co., "Loud Speaker Frequency-Response Measurements," Technical Monograph No. 1, 1944.

flush with the surface of the ground (see Fig. 2). The speaker was fed from an amplifier with a controllable source impedance, and a microphone was suspended at a distance of 5 feet above the enclosure, on axis with the cone. This means that the speaker was radiating into a controlled 180-deg. solid angle, into essentially free space, driven by an amplifier with a controllable damping factor.

The reliability gained by such test conditions involves a certain sacrifice in validity if what we are measuring is musical fidelity. One does not listen to a loudspeaker when one is suspended from a boom in the middle of a field, and in addition the effect of refraction from the cabinet edges, which would be present under any conditions except a bookshelf installation, is not taken into account.

The alternatives, however, are worse. If we test the speaker in a normally live listening room we will get a different frequency response curve for each microphone position and for each room we use, and interpretation becomes difficult. Room resonances may accentuate or suppress various harmonic distortion products. Similarly, diffraction from the cabinet edges will create interference effects that will change the response curve with even small changes of microphone position. Thus RETMA Standard SE-103, in describing methods of measuring speaker pressure-frequency response, states that if there are no manufacturer specifications on mounting for a direct-radiator speaker:

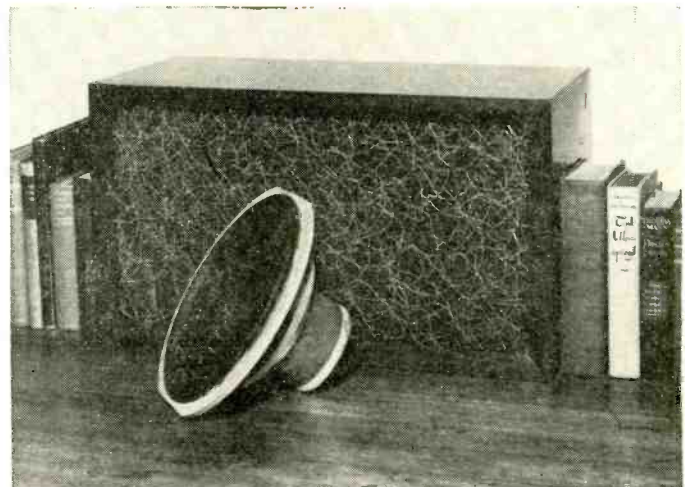


Fig. 1. Acoustic Research AR-1W low-frequency speaker system. The two-way system uses the same cabinet.

* Acoustic Research, Inc., 23 Mt. Auburn St., Cambridge 38, Mass.

¹E. M. Villchur, "Revolutionary loudspeaker and enclosure," AUDIO, Oct. 1954.



Fig. 2. Field measurement of the AR speaker, using General Radio Sound Level Meter (the microphone is detachable).

“... it shall be mounted on a rigid, non-absorbing, effectively infinite baffle. (This implies a radiation solid angle of 180 deg.)

“Substantially free-space conditions shall exist in the acoustical environment of measurement.

“The microphone shall be placed on the axis of the speaker as specified by the manufacturer and at a distance at least three times the maximum transverse dimension of the radiating area. (About 30 inches minimum for a 12-inch speaker.)

“The values of E_G (signal voltage) and R_{SG} (driving source impedance) used in the measurement, and the value of R_{SR} (rated speaker impedance) shall be specified.”

(Italicized portions have been inserted by the writer.)

The conditions of measurement also comply with the recommendations of Standard C16.4-1942, “American Recommended Practice for Loudspeaker Testing,” published by the American Standards Association, for both pressure-frequency response and distortion measurements. The ASA specifies 5 feet on-axis for microphone position.

Under the above conditions the measured data was found to be reliable, and results could be repeated at will. The equipment used included the following:

Krohn-Hite audio oscillator, model 430-AB.

Altec 21-BR-150 capacitor microphone, with cathode follower output.

Freed a.c. vacuum-tube voltmeter model 1040.

(Low-frequency pressure response was re-checked in repeat tests using General Radio Sound-Level Meter Type 1551-A.)

Hewlett-Packard Distortion Analyzer 330B.

Dumont Oscilloscope Type 208.

Validity

In a narrow sense the validity of the tests is assured by the use of established and recognized techniques. The readings did measure r.m.s harmonic distortion, pressure-frequency response, and bass transient response.

In a more general sense, however, it is difficult to state that “flat” frequency response under free-space conditions

represents musical fidelity under normal listening conditions. We know, for example, that the perception of relative bass content in reproduced program material varies with the volume level of the sound, a phenomenon called the Fletcher-Munson effect. Room acoustics, speaker placement, and other listening conditions can strongly influence the actual perception of sound in the final listening.

Validation must then be made by correlating objective data with subjective judgments, and by deductions that cannot, by their nature, be as rigorously tested as can the data itself. It is universally accepted, however, that the avoidance of dips and peaks in the response curve (ignoring slope) is a good thing. The writer then suggests that, considering the sensitivity of control that can be exerted over electronic as opposed to mechanical devices at the present state of the art, any equalization be assigned to amplifier circuitry.³

This leaves us with a response curve for the 180 deg. solid angle which, if flat,

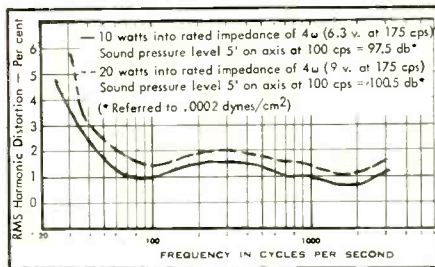


Fig. 3. Harmonic distortion-frequency characteristic of the AR-1W, under conditions noted.

will be transformed into a response that includes boost of the low bass when the speaker is mounted in a corner or at the junction of the floor and the wall. In the case of the unit tested the effective amplifier source impedance can be changed externally by switching from the 8-ohm to the 4-ohm connection, providing flexibility of bass response for different mounting positions. A test run was made with the speaker placed in the corner of a normal listening room, the driving source impedance being low—that is, using an amplifier with a relatively high damping factor. The results of this test are indicative of general performance under such conditions but not as rigorous as the free field tests. Optimum use of the acoustic suspension system, as of any other speaker, is considered to be with an amplifier that has a variable damping factor, which is adjusted to optimum (not maximum) bass response under the conditions of operation. It is agreed among acoustics authorities that there is an optimum source impedance from which to drive a given speaker mounted in a given way for the most uniform and extended bass, but this

³ This applies to the woofer; the problem is complicated in the case of the high-frequency speaker by the differences between on-axis and off-axis response.

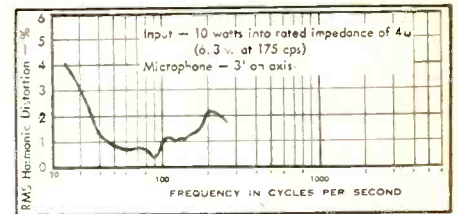


Fig. 4. Harmonic distortion of the AR-1W in the corner of a room.

fact is only recently acquiring general recognition.

General Speaker Characteristics

A brief listing of characteristics of the unit tested appears below:

Model No.	AR-1W
Magnetic circuit	3.3 lbs. Alnico 5 6 lbs. Armco iron
Frame	Cast aluminum
Nominal diameter of speaker	12 inches
Resonant frequency of unmounted speaker	Subsonic
Final resonant frequency of system	43 cps \pm 1 cps
Cabinet	Ribbed $\frac{3}{4}$ in. stock, dimensions 25 \times 11 $\frac{3}{8}$ \times 14 in., acoustically sealed and filled with Fiberglas.

It should be noted that the main factors which determine the final resonant frequency are the mass of the moving system, the cubic volume of the cabinet, and the amount of Fiberglas filling, all of which are readily subject to accurate control. The elastic stiffness of the suspensions, a factor which is not so easily controlled with accuracy, contributes only about 10 per cent of the total elastic stiffness, and the resonant frequencies of different production units can therefore be kept within small tolerances.

Harmonic Distortion

Distortion data is listed before frequency response data in order to validate the former. We are not interested in the total amount of sound put out by the speaker when stimulated at particular frequencies, including spurious harmonics, noise, etc., but in the output of reasonably undistorted sound at different input frequencies. A frequency response rating that extends down to 32 cps has little significance if the harmonic distortion at this frequency is 40 per

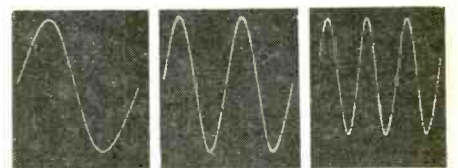


Fig. 5. Oscillograms of acoustic output of AR-1W (conditions listed in Fig. 4) at 10 watts to rated impedance, at 32, 60, and 100 cps, respectively, from left to right. The extreme uniformity of output is accidental, as can be seen from the frequency-response graph of Fig. 7.

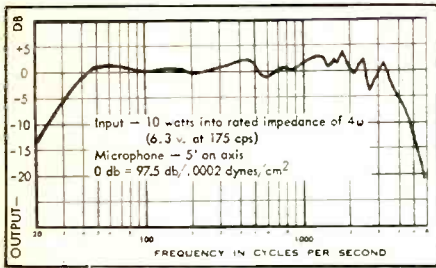


Fig. 6. Frequency response of the AR-1W under conditions noted.

cent at moderate power, other than to indicate that the designer has attempted to extend the bass response further than he should have for that particular speaker. Attenuated output is by far preferable to distorted output. Similarly, a low distortion reading at 32 cps has little positive significance if speaker response is down 20 db at that point. The distortion graph of Fig. 3 should be read in conjunction with the frequency-response graph of Fig. 6, so that the distortion curve refers to the reproduced frequency range, and the frequency response curve refers to the range of low-distortion reproduction. The necessity for validation of the frequency-response curve by distortion data is clearly indicated in ASA Standard C16.4-1942, which in listing essential practices for plotting pressure-frequency response characteristics states:

"Unless otherwise stated, the values of pressure plotted shall be those corresponding to the *fundamental frequencies.*" (Italics supplied.)

The graphs of Fig. 3 plot the r.m.s. distortion-frequency characteristic of the AR-1W at 10 and 20 watts input to the rated impedance (4 ohms). Amplifier gain was adjusted to 6.3 and 9 volts output across the speaker at 175 cps, and left that way for the run. The radiation angle was 180 deg. Figure 4 plots the distortion-frequency characteristic of the AR-1W in the corner of a normally live living room, and Fig. 5 shows oscillograms of the acoustic output of the speaker at 32, 60, and 100 cps, with 10 watts into the rated impedance under the latter conditions.

A word of caution about the interpretation of the distortion figures must be inserted at this point. The reference power levels are electrical, and the inefficiency of the speaker (referring to the electrical power required for a given acoustical power) therefore favors the readings. The sound level is also quoted, but will be meaningless to many readers. The only correct way to compare the data with corresponding data from another speaker would be at the same sound pressure level at a given frequency, not at the same electrical power input. The range of difference in commercial speaker efficiencies is probably at least 25 to 1.

The efficiency of the AR-1W, on the other hand, is close in value to that of several other commercial units for which the writer has a high regard. It should also be noted that the efficiency of the AR-1W remains essentially con-

stant down to very low frequencies (see Fig. 5), and the absolute efficiency in the 30-60-cps octave may be greater than that of another speaker with a much higher over-all efficiency rating. For example, if pressure response at 40 cps is down 9 db (which still allows for an excellent low-frequency reproducer) the efficiency at that frequency is reduced by a factor of 8, and it will require 8 times the amplifier power to create the same sound pressure level as at the reference level. The AR-1W used as an organ pedal tone generator could not be considered an inefficient speaker.

When the 8-ohm connection is used for 180 deg. radiation conditions (mid-wall shelf mounting) the efficiency is halved. The conditions of the 8-ohm connection can be achieved without such loss of speaker efficiency by using an amplifier with a damping factor of 1.

Frequency Response

The graph of Fig. 6 plots the frequency response of the AR-1W under

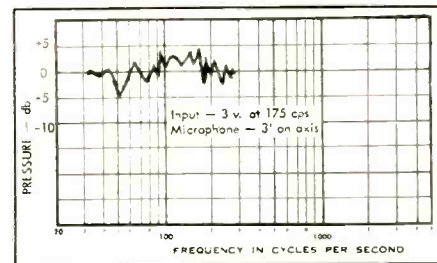


Fig. 7. Frequency response of low range of AR-1W in the corner of a normally live room.

the open-field conditions described above. The ratio of horizontal-to-vertical scale follows RETMA Standard SE-103, which states:

"The length of a 10 to 1 frequency interval shall be the length of 30 db on the ordinate scale."

The graph of Fig. 7 plots the frequency response of the speaker in the corner of a normally live living room, fed by an amplifier with a damping factor of 4.

Transient Response

Good transient response is associated with a uniform steady-state frequency-response curve. The transient response of the AR-1W can be predicted from the frequency-pressure curve of Fig. 6.

The bass transient response was also checked visually with square waves and an oscilloscope. Figure 8 illustrates the response of various speakers to a square wave of subsonic fundamental frequency. In (A) the cone of an ideal speaker moves forward to the top of the square wave and remains completely motionless over the horizontal portion, while air pressure at the microphone decays smoothly. There is no hangover whatsoever. A poorly damped system is represented by the acoustic output in (B), which exhibits definite ringing after the initial stimulus. (C) is the acoustic output of the AR-1W speaker system as

recorded with microphone and oscilloscope, showing slight overshoot.

Efficiency

Efficiency has no direct relation to quality, but it does have an indirect one in that the power demanded from the amplifier by an inefficient speaker may exceed the amplifier rating. If the available voltage driving the amplifier is great enough the amplifier may then overload and distort. It is also true that in A-B tests the louder system tends to sound better automatically, and an efficient speaker has the edge in audio salesrooms if the electrical levels are not adjusted for equal volume from each speaker.

Interpreted in general terms the sound pressure levels indicated in Fig. 6 mean that a good 10-watt amplifier is adequate for the AR-1W or AR-1 speaker for moderate listening levels in typical living rooms. For larger rooms and for those who like very high levels of reproduced sound, at least 30 clean watts are required. The RETMA efficiency rating of the AR-1W at 100 cps is 21.5 db.

In constructing a figure of merit for a loudspeaker system designed for home reproduction the question would arise as to what place, if any, efficiency would receive. If manufacturers were canvassed as to the significant factors in such a

(Continued on page 33)

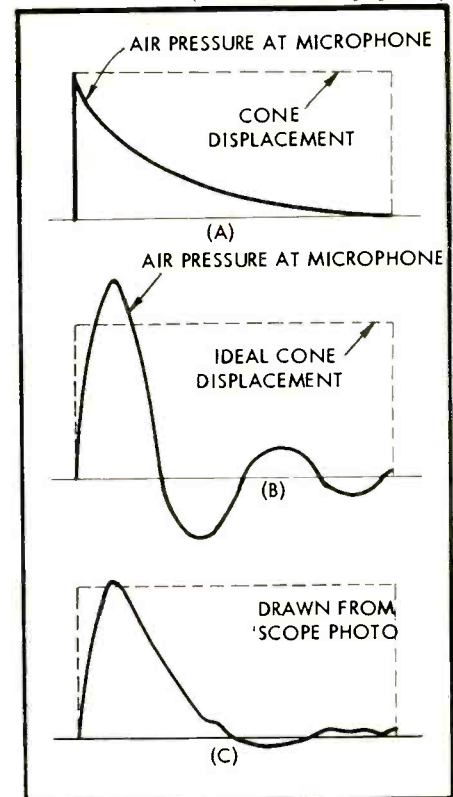


Fig. 8. (A) Acoustic output of a speaker with unlimited and perfectly uniform frequency response, when stimulated by first half-cycle of square wave. (B) Acoustic output of poorly damped speaker system, same stimulus. (C) Oscilloscope photograph of acoustic output of AR-1W to first half-cycle of a square wave of 8 cps fundamental frequency. The rounding of the initial impulse is due to the lack of woofer high-frequency response.

Adapting A Record Changer To Hi-Fi

ADOLPHE F. STERKEN*

Some alterations improve performance of a standard changer.

IN ANY HI-FI MUSIC SYSTEM it is extremely desirable to hold record and stylus wear to the minimum, and also to hold the noise level down as far as the budget will permit. Both of these objectives may be attained through the use of professional turntables and pickup arms, but then we run headlong into the budget problem as well as the inconvenience of sacrificing the automatic feature of the record changer. There is, however, a solution to this problem which is quite inexpensive, and is relatively easy for any hobbyist having a record changer and a few elementary hand tools.

The problem of turntable rumble was solved by the addition of a heavy steel turntable supported by foam rubber cushions on top of the existing changer turntable. As this auxiliary turntable fits freely over the spindle of the changer, records can still be stacked and played automatically as before, a desirable feature where the system is also used as a source of background music. The reduction of record and stylus wear is accomplished by constructing an auxiliary pickup arm having the greater length, reduced tracking error, and friction-free pivots found only on transcription-type arms. As the end of this home-built arm was cut from a plug-in head replacement arm for the record changer, the cartridges are interchangeable between the new arm and the record-changer arm.

The Auxiliary Turntable

The auxiliary turntable which was used (Fig. 1) is a 12-in.-diameter heavy steel disc removed from an old acoustical phonograph. The only alteration required was sawing off the center bearing to a depth of about one-half inch. This heavy disc was chosen for its large mass and inertia which produces the desirable

* 540 S. Crest Road, Chattanooga, Tenn.



Fig. 1. The new turntable assembly (shown upside-down for better visibility) consists of a heavy steel turntable from an old acoustical machine connected by foam rubber to the changer table.

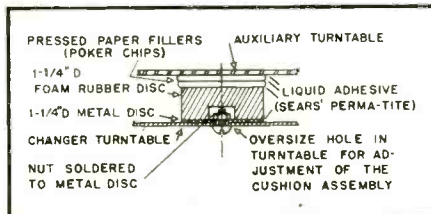


Fig. 2. Detail of the foam rubber pad assembly. A nut is soldered to the inner side of the steel disc and paper poker chips add height.

flywheel action. Earlier experimentation indicated that insufficient mass above the cushions permitted objectionable oscillatory vibration of the record if the cabinet was jarred. It was also found that grounding the upper turntable to the lower one with flexible wire substantially reduced hum-pickup from the changer motor.

The auxiliary turntable was attached by liquid adhesive to the four foam rubber cushions which support it. These cushions absorb vibration from the driving mechanism and permit the application of a more uniform torque to the upper turntable. Each cushion consists of a one-half-in.-thick foam rubber disc 1 1/4 in. in diameter which is cemented to a like-diameter sheet-steel disc. The details appear in Fig. 2. A threaded nut is soldered onto the same side of this disc over a center hole. These cushions were fastened to the record changer turntable by machine screws through holes in the turntable which were drilled oversize to permit lateral adjustment of the cushions in centering the upper turntable. After the cushions were installed, adhesive was applied to the top of each cushion and to the underside of

the auxiliary turntable. The turntable was then lowered into place over the spindle, taking as much care as possible to have it centered when the adhesive coated surfaces come into contact. As the center bearing made higher cushions necessary, cardboard discs were built up on the top of each cushion.

A further improvement can be accomplished by inserting a special stub spindle which is interchangeable with the original after its retaining clip has been permanently removed. This special spindle is a short one made to fit into the top turntable only, thereby mechanically isolating the record from the drive mechanism. Also, it is made oversize to fit tightly into the record center hole for better centering of the record, which materially reduces wow. Using this spindle does necessitate manual changing of the record, however.

The Auxiliary Pickup Arm

Since the record changer's mounting springs permit relative motion between the changer and the mounting board, the arm could not be mounted on the board as a separate unit, but had to be free to move with the changer. This requirement accounts for the heavy outboard flanged plate mounting bracket which is bolted to the edge of the changer base (at left in Fig. 3). This black steel plate, about 3/32 in. thick, was bent on a brake in the sheet-metal shop. Lighter-gauge galvanized sheet steel was selected for the rest of the hinge assembly (detailed in Fig. 4) so that no tools other than two pairs of pliers would be needed to form the pieces. The bearings for both horizontal and vertical

(Continued on page 45)

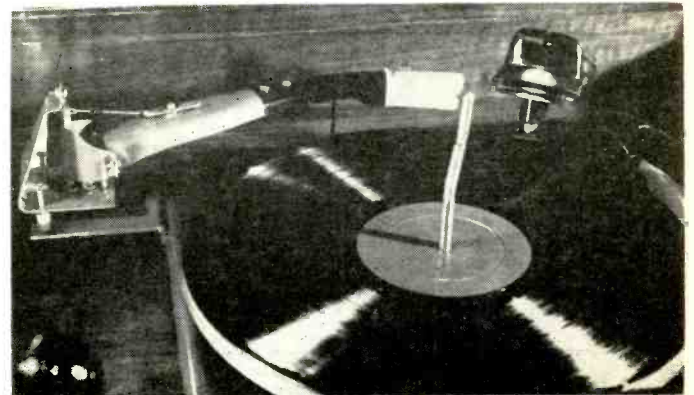


Fig. 3. The new arm is mounted on an outboard flanged plate to accommodate the increased length.

Point-Contact Transistor Amplifiers¹

RICHARD F. SCHWARTZ*

A note on the use of push-pull connections in transistor circuitry.

THE PROBLEM OF OBTAINING HIGHER POWER with less distortion exists in transistor circuitry just as it does with vacuum tubes. Although vacuum-tube practice suggests several obvious ways of reducing distortion, there are several techniques peculiar to transistor circuits alone. The work described here² was done in the early days of transistor development, so that no reference is made to current manufacturers' type numbers.

The Single-Ended Circuit

Figure 1 shows a typical grounded-base transistor audio amplifier, transformer-coupled to source and load. For small signals the distortion is negligible, but as the transistor is driven harder, the output grows larger and begins to show considerable distortion. This arises from the fact that the emitter-to-base path is a nonlinear circuit like a crystal diode. Larger driving voltages cause larger excursions over the nonlinear characteristic causing the resultant current to be distorted. Since in a transistor the output current is proportional to the input current and ideally has the same

waveform, a distorted input current produces a distorted output current. To prevent the input current from being distorted, we must prevent the dynamic emitter resistance change from being large, percentage-wise. This can be done by placing a resistor R_3 in series with the emitter, as shown in Fig. 2, so that the changes in emitter resistance are smaller with respect to the total input resistance.³ Of course, when this is done, the total voltage necessary to drive the transistor circuit must be increased, driving power is wasted in the resistor R_3 , and the efficiency of the circuit is less. However, a good compromise can usually be reached between driving signal available and desired performance.

Another way of looking at the above phenomenon is to say that the transistor is a device requiring a constant-current driving source (such as another transistor or a pentode vacuum tube).

Placing the linearizing resistor as in Fig. 2 has one drawback: it is in the d.c. path as well as the a.c. path. Hence, it may necessitate a change of the d.c. bias to maintain the same operating point. This can be circumvented by either plac-

ing it in series with C_1 or in series with the primary of T_1 , as shown dotted. In the latter case, for the same results the value must be changed according to the impedance-transforming ratio of the transformer.

As an example of the performance of such a circuit, a type A transistor was tried in an amplifier having a resistor in series with the capacitor C_1 . The results are shown in Table I.

The Push-Pull Circuit

For more power and less distortion in vacuum-tube circuits, use is made of the push-pull connection. The same would be expected of transistors. However, before the advent of satisfactory quality control in transistor manufacture, such a circuit would give more power with quite unpredictable results in regard to distortion. Only by careful selection of matched units could distortion be reduced in the ordinary push-pull connection. Even with present-day units, best results can only be obtained by selection.

The ideas set forth in the discussion of the single-ended circuit apply equally well to the push-pull case. That is to say, the amplifier prefers to work from a high-impedance driving source. Figure 3(A) shows how this would be applied for two reasonably well matched units. If the units are not well matched then Fig. 3(B) is more useful since it allows changes to be made in each half of the circuit individually. It is to be noted that this latter circuit only is capable of adjusting each transistor for best performance and cancels no distortion.

A different circuit, in which distortion arising from the use of unmatched units is cancelled, is shown in Fig. 4. Here the same biasing is used for both transistors and a common correcting resistor R_3 is applied in such a way as to compensate for the inherent differences in characteristics. The operation of the circuit may be explained by referring to Fig. 5. This represents the equivalent circuit of the a.c. emitter section of the push-pull amplifier of Fig. 4. The generator E_D represents the distortion voltage produced

* Moore School of Electrical Engineering, University of Pennsylvania.

¹ Work done while with RCA Victor Division, Camden, N. J.

² Patent applied for.

³ This technique is well known, having been used for obtaining linearity in diode detectors. See for example: Edmund A. Laport, "Linear rectifier design," *RCA Review*, July 1938, pp. 121-124.

Table I
Performance Data for Single-Ended Amplifier

Resistor R_3 (ohms)	E_i (rms volts)	E_o (rms volts)	Driver Power total (mw)	Overall Distortion (rms %)	Overall Power Gain (db)	Power Output (mw)	Collector Power Efficiency (%)
0	.15	.15	.218	15.8	11.66	3.2	2.5
210	.44	.15	.607	6.2	7.22	3.2	2.5
500	.79	.15	1.012	3.7	5.00	3.2	2.5
0	.25	.25	.545	28.0	11.21	7.2	5.62
210	.69	.25	1.447	11.4	6.98	7.2	5.62
500	1.24	.25	2.455	7.45	4.67	7.2	5.62

Values of power input for $R_3 =$ zero were computed. Other values were measured.

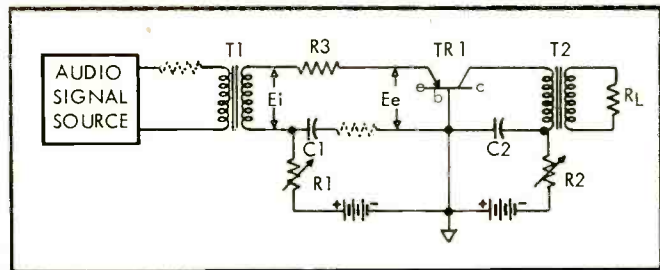
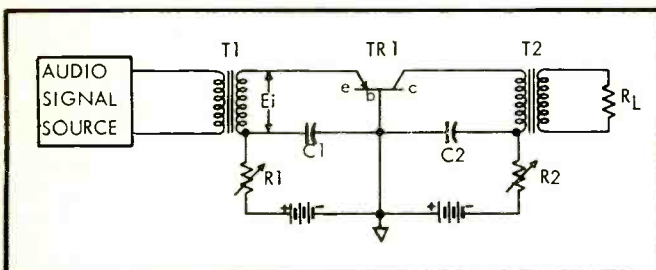


Fig. 1 (left). The grounded-base transistor audio amplifier. Fig. 2 (right). The resistor R_3 in series with the emitter has a linearizing effect.

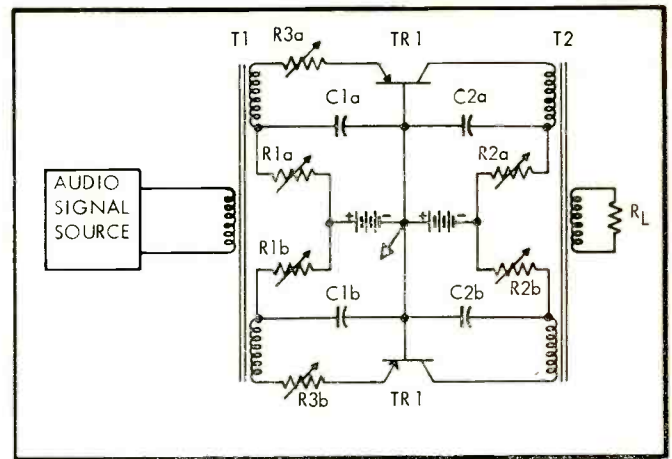
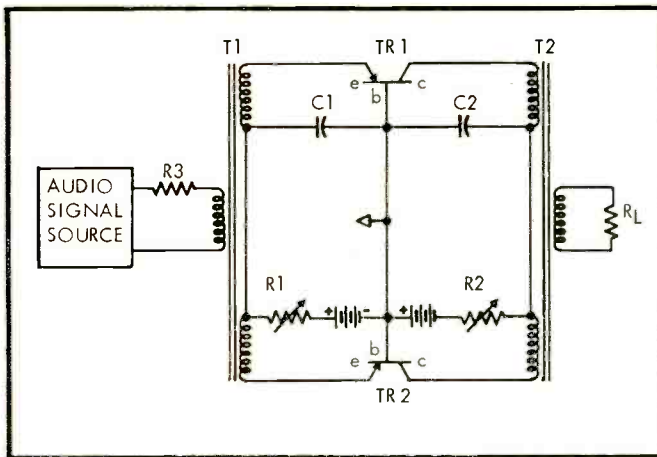


Fig. 3. Push-pull audio amplifiers. At left is a circuit with a single linearizing resistor while the diagram at the right illustrates the circuit having separate resistors for the two transistors.

by one emitter circuit, but not the other. This voltage will cause a current I_D to flow through resistor R_s producing a voltage drop. This voltage drop is applied to the emitter of the second transistor 180° C. from the original distortion voltage E_D . Each distortion produced by each transistor emitter circuit, therefore, injects an opposing distortion in the other transistor. In addition, there is a similar action taking place in the fundamental components of the emitter currents, tending to equalize them. Because of the fact that the resistance needed to cancel one harmonic term completely is not the same as the value needed to cancel another, an optimum value of R_s with respect to overall distortion or with respect to any given distortion term exists. Experimentally, this was found to be of the order of 100 to 200 ohms for all the transistors investigated. This value is, of course, very much smaller than the value of the biasing resistor R_i of Fig. 4.

The use of balancing resistors in push-pull vacuum tube amplifiers is well established; for example, the common cathode resistor for balancing plate currents, and the common grid resistor for balancing high audio-frequency grid voltages. However, in both these examples, a different action takes place from that which occurs in the push-pull transistor circuit. In the case of the transistor, a.c. emitter current flows at all times and thus produces the correcting action. The correction takes place at all frequencies. Furthermore, the correction resistor has a linearizing effect on the emitter circuit. There is no de-

generation produced by this resistor comparable to the degeneration effect in a common-cathode-resistance push-pull vacuum-tube amplifier. Nor is the circuit action the same as the second example cited, for in the push-pull vacuum-tube amplifier grid current does not flow continuously.

Table II shows a typical set of data on the performance of the circuit of Fig. 4. The dissimilarity between the two transistors is clearly shown by the unbalance in a.c. emitter voltages (E_{e1}/E_{e2}) and d.c. emitter and collector currents. However, the a.c. collector voltages are not too dissimilar. The introduction of R_s decreases the dissimilarity.

Other dissimilar transistors were tried in this circuit with comparable results.

It can be seen in Table II that for an output of 7.2 mw the over-all r.m.s. distortion was reduced from 27 per cent to 2 per cent. For this improvement, the driving voltage had to be increased by a factor of nearly 2. Comparing this to the data in Table I, it is seen that the distortion improvement in the push-pull circuit does not require as much increase in excitation as does the single ended circuit. The collector power efficiency is low and of the same order as in the single-ended class A amplifier. It is changed only slightly by the addition of the compensating resistor R_s .

Table II

Performance Data for Push-Pull Amplifier of Figure 4

Resistor R_s (ohms)	E_i (rms volts)	$\frac{E_{e1}}{E_{e2}}$	D.C. Emitter Currents		D.C. Collector Currents		$\frac{E_{c1}}{E_{c2}}$	Output Analysis				
			Transistor #1 (d.c. ma)	Transistor #2 (d.c. ma)	Transistor #1 (d.c. ma)	Transistor #2 (d.c. ma)		(cps.)	$E_{c1} + E_{c2}$ (rms volts)	Overall Distortion (rms %)	Power Output (mw)	Collector Power Efficiency (%)
0	.100	.781	1.10	.05	4.44	.78	1.57	400	1.55	27.0	7.2	4.55
								800	.362			
								1200	.125			
								1600	.068			
								2000	.034			
105	.195	.411	1.00	.15	4.18	1.16	1.25	400	1.55	1.95	7.2	4.45
								800	.007			
								1200	.025			
								1600	.016			
								2000	Trace			
								2400	.001			

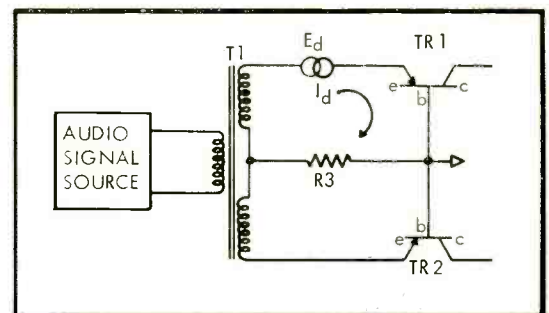
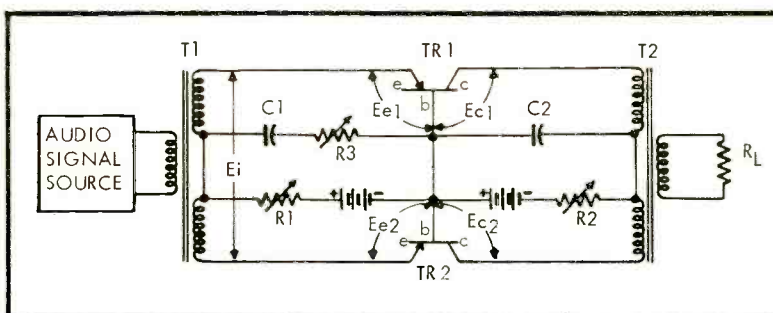


Fig. 4 (left). A low-distortion push-pull amplifier. Fig. 5 (right). Equivalent circuit for the amplifier of Fig. 4.



Fig. 1. This aerial view shows the stadium. The Field House is at left and the Practice Building in the foreground.

Sound Engineer At Work

W. H. JOHNSON*

Sound-system specification and layout is not so simple as it may seem to some. This article shows how experience, thought, and good equipment can be combined to create a system which brings sound to the paying customers instead of broadcasting it over the countryside to unwilling or unauthorized ears.

MISCONCEPTIONS ABOUT SOUND are among the most prevalent misfortunes of the audio industry today. To the average person a sound system is just a means by which a sound or noise (and often more noise than sound) is amplified to a point loud enough to hear, without thought of quality of either equipment or results. It is assumed that the sound engineer merely looks into his crystal ball and utters a few words of magic (or profanity), and out comes a Handy Dandy Little Six power amplifier complete with speakers and microphones, leaving only the artist or announcer to be procured. This school of thought brings about the belief that the sound engineer can supply a sound system for \$200 or \$300 that will correct all architectural acoustical defects, the effects of wind and rain, and any other condition that may exist short of fallen arches or ingrown toenails.

However when the sound engineer is given the opportunity of designing and building a proper system for a specific purpose the end result is a happy engineer and a still happier customer.

* 809 Monroe Street, Racine, Wis.

Such were the problems of sound as presented to Altec Lansing sound contractor Satterfield Electronics of Madison, Wis., and to their Chief Engineer, S. N. (Sid) Vinge. Sid was contacted by Richard Knoff, Chief Electrician of the University of Wisconsin; and after consultation with the Athletic Department and other University of Wisconsin officials, he was commissioned to produce sound for the Stadium (Fig. 1), Field House, and the new Athletic Department Practice Building.

Work was started, and at the eleventh hour it became necessary to have the system in operation for the 1954 Homecoming Game. Sid placed his orders for components, horns, speakers, amplifiers, and consoles, with the instructions that the material be flown by air to the site. At 9 o'clock on Thursday morning a large cargo liner touched its wheels on the Madison Airport, and three days later on Saturday at noon the system was completely installed and ready for the football game at 2 in the afternoon.

Sid and his staff were not idle while waiting for the material to arrive, but were hard at work laying cable, laying

out circuit and working drawings; and Mr. Knoff of the University started the design and construction of the frames for the stadium speakers and the projectolier for the field house. So completely was this project planned that not one moment was lost—for by no other means could this complete system have been assembled and installed in the less than three days that were allotted.

The operation of the system is very simple, yet so well conceived and designed that every possible function desired of it can be properly handled. The operational base of the system is the control console in Fig. 2, composed of an Altec 1560A console with three Altec 1510A preamplifiers. This presents six 30/50-ohm low-impedance microphone inputs, each input having an associated gain control with an "on-off" key for each microphone line. The console also contains provisions for input of two 600-ohm lines, each having its associated gain control and key switch. These positions are such that the console can feed two program or telephone lines or receive the feed from two 600-ohm lines, according to the requirements of a par-

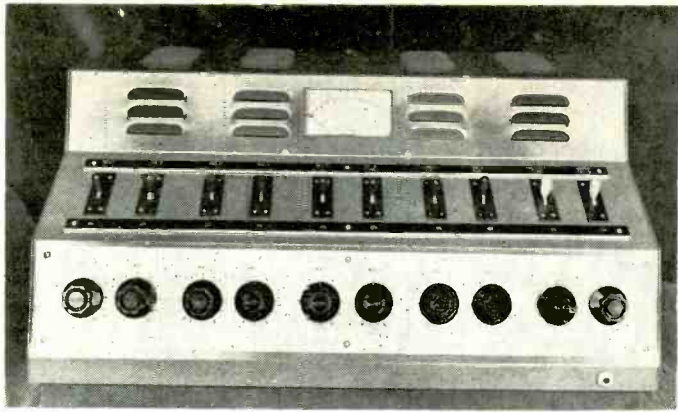


Fig. 2. This control console is the brain center of the installation.

ticular event or activity. Cue facilities are included and both aural and visual monitoring provisions were made.

Because of the varied activities held in a university Field House and Stadium the speakers are divided into four groups—those serving the north, south, east, and west ends of each building. Each speaker group has an associated 70-watt Altec Lansing 1530A power amplifier. The amplifiers are mounted in two enclosed cabinets located in the Field House at the south end of the stadium. By means of patch cords the Stadium speaker lines, the Field House speaker lines, and the Practice Building speaker lines are connected to the amplifier associated with each speaker group. Also in the recessed patch-cord panel are a group of switches which permit the instantaneous connection of any speaker group to another power amplifier should a tube failure occur during operation of the system. Also included in the section is a voltmeter to read the peak voltages

on any speaker line and to read the condition of both the line and the amplifier.

Microphones used are Altec 660 dynamics. They are located in the press box in both the Stadium and the Field House, and field function microphones—for between-the-half ceremonies—may be plugged into buried receptacles on the 50-yard line. In the Field House microphones can be connected to locations on the floor and elsewhere in the building when necessity dictates.

In addition to the building of the twelve frames for the field speakers (each consisting of an Altec H1003 multicellular horn and 290C compression driver with 70-volt line transformer) there was the problem of mounting the speakers in the Field House. These speakers are also Altec units; the projectalier of Fig. 3 contains four 803A 15-in., heavy-duty, cone-type loudspeakers in 612 cabinets and four H1803 multicellular horns complete with 290C drivers and four N500C networks. The finished projectalier weighed just over 1800 pounds and is supported by stainless steel cables (5-ton capacity) on an electric winch to raise and lower the complete assembly.

As one picture equals a thousand words the photographs accompanying this article will show more at a glance



Fig. 5. Twelve of these horn-loaded speakers are around the Stadium. Mounted almost at ground level and directed slightly upward, they project sound toward the listeners who are located on the rising tiers and thence into space rather than into the town.

than this writer could set forth in several pages. These photographs show an example of a properly engineered sound system. Other systems had been used, but with sad effects. Speakers mounted on the field house and projecting over the stadium told the city of Madison what was happening at the game while the paying customers heard little. When speakers were mounted at the opposite end the sound was reflected from the Field House wall in such complex waves that again the sound was unintelligible. But application of sound engineering principles by Sid Vinje in placing four speakers on each side and two at each end, and facing them into the crowd, has brought the projection of sound to where everyone present can hear and understand what is said. The townsfolk who cannot listen to the games by radio from long projection paths of misplaced speakers.

Sound engineering is an art and when the art is properly applied a system like that at the University of Wisconsin is the

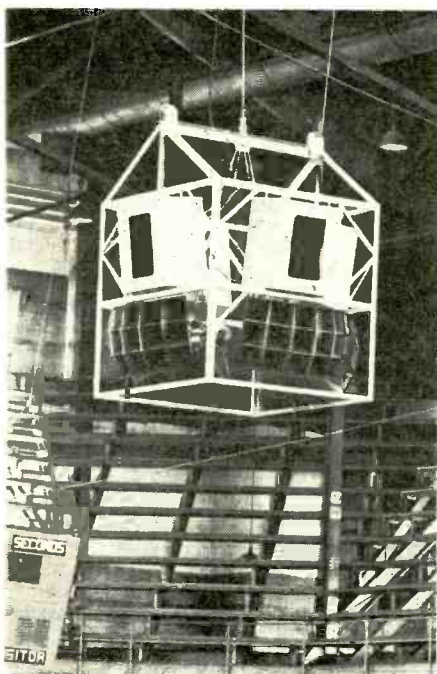


Fig. 3. The projectalier is hung on cables and can be raised and lowered by a winch.

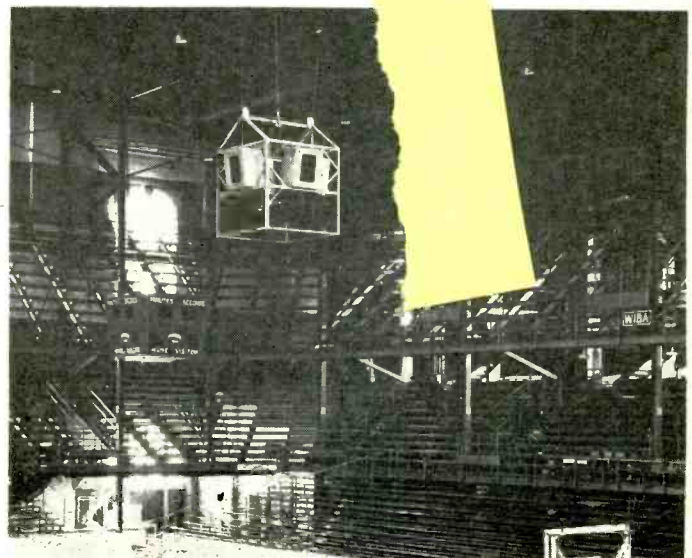


Fig. 4. The projectalier of Fig. 3 looks like this when hoisted into operating position.

LONDON LETTER

(from page 7)

Leak and the Acoustical electrostatic speakers are referred to the articles which have been appearing by their respective inventors in British journals. The Leak equipment has been dealt with in the May issue of *The Gramophone* and P. J. Walker has written three articles about his speaker which have appeared in the May, June, and July issues of *Wireless World*.

H.M.V. Stereosonic Tapes at 7½ ips

The B.S.R.A. Show enabled a further hearing to be made of the H.M.V. stereosonic tapes, and for the first time, H.M.V. gave a demonstration solely at 7½ ips on what is claimed to be the equipment which will be marketed in the Autumn. It is believed that the two cabinets with 10-watt amplifiers, one fitted with a record changer and the other with a dual track tape deck will cost about \$1000.

It was possible to hear only part of the demonstration and the excerpt from "The Marriage of Figaro" was again very convincing. On the other hand, your correspondent feels that until one knows the price of the tapes, it is very difficult to pass an opinion as to whether or not all this is worth while. The equipment will cost almost double the price of a single channel unit. It may well be that the tapes will cost three or four times the amount of comparable performances on records and until this information is available, it is difficult to forecast whether many Audio enthusiasts will be prepared to embark in such an installation in their homes. Nevertheless, H.M.V. are to be congratulated on their new policy of being progressive which, unfortunately, they have lacked for so many years since the War.

Immediately after leaving the H.M.V. demonstration we listened to the Leak one mentioned above. Without hearing one demonstration side by side with the other, it is difficult to pass an entirely considered opinion, but many visitors to the Show thought that an orchestra on the Leak electrostatic-moving coil combination sounded no less like an orchestra than when heard stereosonically on the H.M.V. equipment. Furthermore, H.M.V. had the advantage with the orchestra being on tape whereas

Leak had to reproduce from ordinary commercial records which theoretically, have much more distortion than a tape which is being made direct from a master tape.

Knocking Loudspeakers with a Hammer

During the B.S.R.A. Show, Gilbert Briggs again filled the Royal Festival Hall with an enthusiastic audience to listen to his second London lecture-demonstration of live and recorded music. These affairs have now created such interest that even the staid newspaper, *The Times* which rarely refers to commercial activities, devoted nearly half a column to Mr. Briggs' latest venture. Many visitors thought that the demonstration was much better than the one held some months ago, for a chairman was dispensed with and there was less talk and more sound. Nevertheless, one could not have too many comments by Gilbert Briggs for he has a flair for giving a lecture of this kind and possesses a remarkable wit and ease of delivery. The comparisons on this occasion were even more interesting because they included live and recorded performances of the harpsichord, piano, Great Festival Organ and a choir of 50 voices. Changes were made either way. In some cases the recordings were heard first and in other cases, the artistes. He is probably the only lecturer in the World who has commenced his lecture by hitting the beautiful cabinets of the loudspeakers with a hammer in order to demonstrate the difference in resonance between those which were lined with tiles and those with sand.

The demonstration started with an Audiophile record, "Memories of You" AP-7 being played on two 8-in. Wharfedale Speakers in RJ cabinets. Briggs makes these RJ cabinets in England under licence from America. The other loudspeakers on the platform were assemblies of his 15-in. speaker with two or three treble units. Four of these assemblies were available and were used together or separately according to the type of recordings being reproduced.

One tremendous advantage possessed by Briggs is the co-operation of P. J. Walker, who is responsible for operating the records and controls of his Quad amplifiers. Walker seems to be able to estimate better than anyone else the correct setting of a gain control for the reproduction of records. The reproduction of the Nixa record of a piano duet of "Variations in B Flat" by Schubert was, your correspondent thought, more realistic than a stereosonic tape of



The Philips tape recorder, weighing only 21 lbs., incorporates a microphone, two reels of tape, and one empty reel. Single knob control operates through seven positions, and separate gain controls are provided for recording and reproducing.

piano music heard at the H.M.V. demonstration, largely because the piano in the Festival Hall was not reproduced too loud whereas the H.M.V. reproduction just did not sound like a piano.

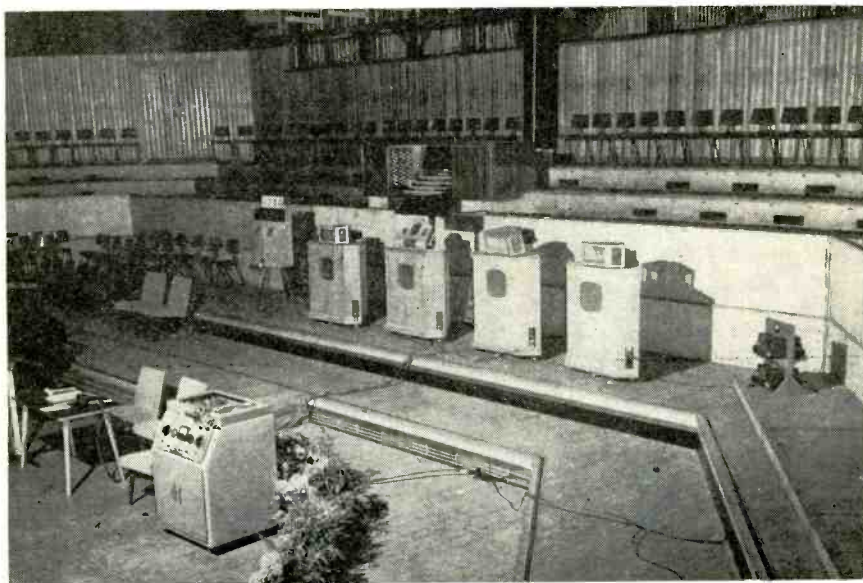
Tuning-up Records

Audio enthusiasts were interested in the method of showing the number of watts used. A system of indicators were mounted in the centre of the stage and showed instantaneously the watts being fed to the speakers at any appropriate moment. In some cases, when a direct comparison was being effected between the live and recorded performances, Briggs had recorded tuning up notes on the records so that Walker could adjust the Garrard variable speed transcription motor to ensure that the pitch of the record was identical with that of the instrument on the stage. As Briggs said, it was common for orchestras and artistes to tune up in a Concert Hall and he therefore did not see why a record also should not be tuned.

Possibly the greatest tribute to Briggs' lecture was that during some of the records there seemed to be considerably less coughing and background noise from the 3,000 visitors than is usually the case when a live orchestra is playing in the Hall. So as to reduce scratch, some of the Record Companies had co-operated by supplying metal positives of the records used. Special recordings of the choir had been made by E.M.I. on tape at 30 ips. At the conclusion of the demonstration, Mr. Briggs revealed that in the Autumn he hopes to stage a similar demonstration in New York.

He must be getting publicity minded, for whereas in the first Festival Hall Show, the name Wharfedale was not mentioned at all, neither did his trade mark appear on the stage, at this demonstration he did mention once the name of his loudspeakers.

As all seats for these demonstrations in England have been sold out within a day or so of the announcement of the dates and more than 500 people on each occasion immediately bought all the standing room, American Audio enthusiasts would be wise to make early application for their reservations for the New York lecture, which is scheduled for Town Hall on Sunday, Oct. 9, at 3:00 p.m.



Stage set-up for the Festival Hall concert.

Equipment Report

Radio Engineering Laboratories' "Precedent" FM tuner—Recheck for Crestwood 304 Tape Recorder

THE FIRST HIGH-FIDELITY FM receiver was constructed for Major Armstrong in 1936 by a trio whose two surviving members are now the president and vice president of Radio Engineering Laboratories. The first model looked more like a "ham" transmitter than a radio receiver, but the present model retains little of the appearance of its predecessors. However, the performance and stability are still there—to an even greater degree.

As shown in Fig. 1, the Precedent is as sleek and aristocratic looking as one might wish. The dial, tuning meters, and the name are softly lighted, the styling is functional, and the dial is calibrated with laboratory accuracy. The two meters are easily read, with one showing the exact center-point for tuning and the other indicating the signal strength of the received signal. The large knob controls the tuning, while the others control r.f. and audio volume.

The tuner is constructed in an unusual form, called by the manufacturer the "Thermocube." It consists of three chassis mounted vertically, in effect, with r.f., i.f., and audio tubes projecting into an "air shaft" which extends from top to bottom through the receiver. When the unit is removed from its protective cage, practically every component is exposed—the exceptions being those in the r.f. tuning section, which has a separate bottom plate. At the right is the r.f.-i.f. section; the limiters and the audio section are at the back; and the power supply section is at the left. The protective cover is held in place by two Cam-Lock fasteners. The rectangular frame around the panel simply snaps into place, may be removed instantly to replace dial lights or to reach the mounting screws.

All connections are made to the rear of the unit. The power leads are attached to the cover, and engage the input receptacle only when the cover is in place. High and low impedance outputs are available—one

at an impedance of some 3000 ohms designed to feed high-impedance loads with an output of approximately 2 volts while the other is designed to feed a 600-ohm line with a level of 0.2 volts. A third output jack is provided, normally wired to the high-impedance output, but available for connection ahead of the de-emphasis network, if desired, for multiplex operation or for use with certain types of stations which transmit ultrasonic control signals to cut off commercial announcements. The antenna connections are made through a built-in receptacle which accommodates 300-ohm transmission-line plugs.

Circuit Arrangement

From the circuit standpoint the Precedent differs appreciably from any other tuner we have examined. The input to the first grid of the 6BK7A cascode r.f. stage is double tuned, as is the transformer between the r.f. stage and the first detector. A 6J6 is used as the mixer and oscillator, with the oscillator coil consisting of a silver winding deposited spirally on a glass tube. Added selectivity and protection from near-channel strong signals are provided by this additional double-tuned circuit.

The i.f. amplifier consists of five stages, with flat-topped tuning to provide a band pass of 170 kc at the 6-db points. The second and third i.f. stages (as well as the input section of the r.f. stage) have their grid returns connected to the r.f. gain control so as to adjust sensitivity of the user's local conditions.

A three-stage pre-limiter amplifier follows, using diodes in the grid circuits as grid resistances; the signal meter is connected in the grid return of the third of these stages. Two limiter stages follow, with diodes actually serving as limiters while the tubes themselves are amplifiers. The diodes remove amplitude modulation

from the signal. The wide-band discriminator follows, and it in turn feeds a cathode follower output stage, with feedback from the follower to the first audio stage.

The power supply uses a 5Y3GT rectifier, with choke-capacitor filtering for audio frequencies, and with numerous r.f. chokes throughout—nine being used in the plate and grid supply circuits, and seven more in the heater supply circuits. It is not likely that there is any stray r.f. anywhere in this receiver.

Performance

The performance of the Precedent at a location 20 miles east of New York city indicates a high degree of sensitivity. With no connection to the antenna input jack, there was no signal whatsoever anywhere in the band. With four inches of wire in one of the jacks, every N. Y. station came in with sufficient strength to provide satisfactory listening. With an antenna connected—a 5-element Yagi beamed on the Empire State building as nearly as possible—one Philadelphia station was played, with a signal-to-noise ratio of approximately 15 db. Philadelphia is nearly 100 miles air line distance, but it is 30 deg. off the beam of the Yagi. Rotating the antenna to maximum signal gave completely satisfactory reception from the Philadelphia station.

No a.f.c. is used in the Precedent, but the stability is such that none is necessary, and dial calibration is accurate enough that one can tune in a station with the volume down, using only the scale calibration. Then when the volume is turned up, the station is there. Judging from the tuning meter there is no perceptible drift from cold start through ten hours of continuous operation on the same station. Again turning the set on after an overnight cooling period, the station was found to be tuned in properly.

The signal strength meter is an interesting feature. Instructions indicate that the r.f. gain control should be set so that the meter is from $\frac{1}{2}$ to $\frac{3}{4}$ scale for avoidance of overload of the r.f. and i.f. stages. This would be normal operating procedure. But with the gain control at full on position, signal strengths are indicated by the position of the pointer—ranging from 40 μ v at the $\frac{1}{4}$ scale position to 5000 μ v at full scale. With the gain control at the half-way position, signal strengths ranging from 450 μ v to 70,000 μ v are indicated.

Our observations indicate that the Precedent well justifies its reputation. It is the logical answer to the demand for a maximum of quieting, high sensitivity, and excellent stability. It is especially recommended for use by anyone who needs a reliable FM tuner for such applications as recording off-the-air programs, where any noise is intolerable. It is also recommended for locations where signal strength is something less than ideal, and it would be appreciated for its engineering, for its performance, and for its external appearance—tops on every count.

RECHECK FOR CRESTWOOD 304

Since our findings differed somewhat from those of the Crestwood engineers as to the performance from record in to playback out on the Crestwood 304, reported last month, we are going to have another go at it. It is just possible, suggest the Crestwood people, that (1) we made a mistake, or (2) one switch contact was not making good contact. Since the playback from standard tape curve checked almost exactly with theirs, we think that one or the other of those possibilities is correct, and we shall look again.



Fig. 1. The REL "Precedent" FM tuner.

AUDIO ETC.

Edward Tatnall Canby

IS THERE ANYONE who hasn't yet heard of Edgard Varèse? He is the man who suddenly became famous a few years ago as the First Hi-Fi-Demonstration Composer. The demonstration piece was called "Ionisation" and the LP recording that rocketed him to fame included a couple of other shockers as well—"Intégrales" (for screaming brass), "Density 21.5" (for flute). You can still get it on EMS 401 and you'd better do so if you haven't heard it.

You see, Varèse's sudden hi-fi fame was a bit delayed. He wrote the music way back in the middle Twenties, when hi-fi hadn't even hatched from an early-type vacuum tube. But, as we all discovered at several Audio Fairs and a couple of thousand home and sound-salon demonstrations, Varèse is a clairvoyant. Fully a quarter century before the hi-fi boom was even imaginable, this man was able to write the most concentratedly effective demonstration piece for hi-fi equipment yet produced—and competition is pretty hot on those lines right now.

Well, Varèse is at it again (1952-54) and a few weeks ago I was planked down right in the middle of his newest opus, a work with the ridiculously modest title "Deserts"—to cover 25-odd minutes of the most overwhelming sound I have ever experienced. It wasn't really any coincidence that "Ionisation" so neatly anticipated the sounds that we hi-fi bugs now like. Nor is it hard to see that "Deserts" may be equally clairvoyant in respect to the further future. For Varèse is one of this century's big experimental minds, an audacious, cocksure, brilliant, eccentric, fabulously skillful brain of the sort that people in every age have found either amusing or plain crazy—at the time.

Let me tell you about "Deserts." It was a positively spine-chilling experience, especially since I was in on the rehearsals and the setting up of the performance, helping with the arrangements, as the old phrase goes. Help was needed—but decidedly. For this gigantic bit of Varèse whimsy includes not only a fiendish percussion-style orchestra of live musicians that combines the blood-curdling dissonance of "Intégrales" and its brass with the extraordinary varied percussion effects of "Ionisation," the two tripled in hitting power—but to the live orchestra is added . . . you guessed it—taped sound.

Not any ordinary echo-chamber, play-it-backwards tape but a new kind of taped sound worthy of the Varèse mind: there are *two* taped sound channels, not merely one, and they are played antiphonally on opposite sides of the performing hall, with the live musicians sandwiched inbetween; the Varèse intention, expressed to me in so many words, was very simply to overwhelm the sound of live musicians with the greater power of the machine! I assure you, the

overwhelming was hugely successful—via two vast batteries of the biggest speakers we could get hold of and a pair of 50-watt McIntosh amplifiers going full blast.

At the end of the performance, which was held in the big National Guard Armory at Bennington, Vermont, as part of Bennington College's Symposium on Music and Art, the jammed-in audience stood up and stamped and yelled and cheered for minutes, so violent was the sheer emotional impact of the big piece. And a good half of them sat right down again to hear the entire thing through a second time, from beginning to end but louder. It didn't really matter much whether you were an artist or a musician or an engineer—for this was a work that hit you directly in the solar plexus, via the ears, and no time for intellectual fussings and arguings. You didn't *like* or *dislike* this stuff, you felt it. Old Varèse is really a powerhouse!

Present and Impressed. . . .

Ask Bob Paulson of Ampex-New-York, for instance, who was there to watch one of his double-track stereophonic Ampexes go through its paces to produce both of the two sound-tracks. Or ask the twenty-odd musicians who did their stuff, via the highest powered brass, woodwind and percussion both standard and exotic (including, for instance, two fat leather sofa cushions, to be slapped hard by long wooden paddles). Or, if you have a chance, you might ask Roger Sessions, one of the most profound and learned of modern composers, who was unexpectedly impressed by the Varèse sounds and even asked for the score (of the live portions), to follow it during the performance. Sessions stands for no silly nonsense and faddism. If Sessions is impressed, by your music, you may be sure you are at least on the inside track towards a possible Beethoven.

Or, again, you might ask Ann McMillan loaned by RCA Victor, who hasn't recovered yet. She was listed among the performing musicians, as "sound technician," and she presided at the Ampex, throwing cues to the conductor, starting and stopping the taped "interpolations" with split-second timing. She had been loaned to Varèse during many months of earlier preparation, to help assemble the taped portions of "Deserts," and like a good editor she worked with stopwatch on wrist following the tape "score"—a gaudy graphed document in several colors and on several lines that measures off the tapes precisely in terms of seconds.

Or, finally, you might ask Varèse himself. He would be glad to tell you all about it—for needless to say, he was present and super-active at rehearsals and performance, gabbling away in his benignly unintelligible French-English, conducting the conductor,

beating out the percussion rhythms in the air—"da, Da, YOMP, zeezee, BRRRR, pouf, TYAAAAAH—you-see-how-simple-et-is!"—grabbing the Ampex controls at unexpected moments (and with unexpected results), beaming beatifically when the volume reached towards 120 db Absolute while rows and rows of us mere mortals were mowed down, hands over ears. (He can hear a whisper, too, as well as you and me.)

Varèse told me a few weeks before the big show, with a gleam in his eye, that he was going to "stereophonize" the big armory, as though this were a thing for joyful anticipation on the part of all concerned. It turned out to be just as he said. He *did* "stereophonize" it, if we overlook the minor technicality that two simultaneous sound-tracks with *different* content do not actually make for a stereophonic effect. Perhaps yes—with imagination, and Varèse has plenty of that. This man has the serene and good humored confidence and geniality that comes from knowing *exactly* what he wants and knowing, too, that, quite obviously, the rest of us will come to understand him eventually. Haven't we already? Of course! After all, he's been in this business twenty or thirty years. He's no eager newcomer.

That's the overwhelming impression you'll get from Varèse himself, and you'll believe it wholeheartedly. He's extremely likeable and he's as enthusiastic about recorders and amplifiers and matching impedances as he is about Mexican gourds and green leather cushions and trumpets, trombones, tubas, all of which are grist for his mill and all of which he can wield with the experienced hand of a master.

ABABABA

Let me give you a better idea of "Deserts" in detail. The work has seven interconnected divisions, played continuously, that might be designated as ABABABA, the A portions of the sound coming from the live musicians, the B portions from the dual simultaneous taped sound tracks. The work is unbroken, flowing smoothly and dramatically from one medium to the other and its most immediately impressive feature is the remarkable resemblance and relationship between the taped portions—derived largely from "industrial" noises, factory sounds, vast screechings of ripping metal, enormous saws, trip-hammers, mountains of crashing debris, frictions, rubbings, steamings, hissings, explosions—and the live portions, derived in the main from accepted musical instruments. At first you aren't sure whether the orchestra sounds like the factory or the factory like the orchestra; but you soon decide that it doesn't matter a bit. It really doesn't.

There is no simultaneous taped and live sound in this work. The two types are contiguous, the transitions smoothly and neatly calculated. But at no point does the conductor try to "conduct" a tape, nor does the tape "conduct" the conductor.

There, I think (though it is merely my guess) is the profoundly musical best reason for Varèse's procedure. He feels, I suspect, that to combine the pre-determined, fixed, rigid patterns of taped sound with the basically flexible, un-fixed human expression of a live performer is a contradiction in aesthetics that is inadmissible. At least, inadmissible without very special compromises that were of no interest and importance for this particular piece.

Just try playing your own piano (or flute or guitar or what-have-you) to one of those recordings with a part missing, and you'll feel this contradiction. Indeed, here is perhaps the most important basic difference between present-day *performed* music and the much-talked-of direct taped music

(Continued on page 37)

PRESTO PROUDLY PRESENTS



THE *Pirouette* T-18

**a triumph of new design...
the world's finest hi-fi turntable
for professional and home use**

Topping the achievement reached by all previous PRESTO turntables is the new PIRQUETTE T-18. This magnificent mechanism is streamlined to the nth degree...inside and out. Its beauty and balance of design...its brilliant performance...has inspired the name PIRQUETTE...winning entry in a nationwide PRESTO contest run for hi-fi fans and experts. There is no finer choice than PIRQUETTE T-18 for rugged professional use or home enjoyment.

PIRQUETTE has all the revolutionary PRESTO developments

in turntable design. The famous flick shift that selects 3 speeds with a simple sideway motion of the single control lever. The single movable plate on which the 3 idlers are mounted is the heart of the mechanism! Elimination of trouble-making arms and shift cams. All in a heavy weight turntable that looks unbelievably light and graceful...in sleek telephone black and brushed chrome finish. Mounting requires simple rectangular cut-out.

Price: \$53.50; with hysteresis motor \$108.

**See PRESTO's PIRQUETTE T-18 at the Wescon Show
Booth 1627 August 24, 25, 26**

PRESTO

RECORDING CORPORATION
PARAMUS, NEW JERSEY

Export Division: 25 Warren Street, New York 7, N. Y.
Canadian Division: Instantaneous Recording Service, 42 Lombard Street, Toronto

WORLD'S LARGEST MANUFACTURER OF PRECISION RECORDING EQUIPMENT AND DISCS

PRESTO RECORDING CORPORATION,
High Fidelity Sales Div. Dept. A
PARAMUS, NEW JERSEY

Please send me illustrative data and specifications on the new PRESTO PIRQUETTE T-18 turntable.

Name.....
Address.....
City.....
Zone.....State.....



EDWARD TATNALL CANBY

GHOSTS IN BROAD DAYLIGHT

AS LONG AS I'm with this magazine (or any other) I will never do a ghost review—that is, a review under my own name that in actuality is by somebody else. I hear tell of such things elsewhere and I can hardly blame those who find that two ears and one mind just aren't enough to keep afloat with, today, under one name. Ghosting was a brilliant idea and still is—you can have your cake and eat it too. Moreover you can always say that you have seen the material and approved of it, as do our public officials who read their own ghosted speeches out loud!

But not here. I begin an experiment this month which will help us better to cope with the ever-increasing floods of new records, so many of which today are merely repeat recordings of works already released several, or maybe a dozen times. I'm a slow listener and I'm glad of it, though it would be nice to be able to run all records at 66 2/3 rpm (or maybe 78) and "decode" them into neat critical reviews in half the time. That's impractical. And so I'm getting in some outside listening help—and telling you so.

Ghosting in broad daylight, you might call it, though the actual comments, as you'll find, are written by myself. The records which follow have not been heard by me. The listening is by somebody else—the responsibility is mine. A scout who shall for the moment remain ghost-like and anonymous has played them all and attached informative little typed cards to each, for my (and your) benefit. On the basis of these I have rejected many discs, saved some on his recommendation, and have added my own comments as the situation seemed to require. The writing, I hasten to repeat, is strictly mine, non-ghost, except for quotes, direct and indirect, as indicated. But I have the benefit of scout's counsel, as you will see.

The material I have submitted for this daylight ghosting is, you will note, mainly of the standard concert repertory sort. I've been checking with this particular ghost's ideas on such works for a good while now and I think I know pretty well when we're liable to disagree and what sort of music will get a useful and fair criticism from this source.

If the idea works—and I'm quite enthusiastic about it—we may call in other plainly labelled ghosts as well. And who knows—they may eventually blossom out into real, live record critics!

We'd be glad to have your comments on

the new system, after you have read through this month's contribution.

Our Scout Tells Me . . .

(NOTE: These comments combine my own observations with those of "Scout #1," as described above.)

TCHAIKOWSKY & CO.

Tchaikovsky: Piano Concerto #1.
Grieg: Piano Concerto. Friedrich Wührer; Pro Musica Symphony, Hollreiser.
Vox PL 9000.

"Eminently sensible and practical coupling," writes Scout #1, and he says the recording is extremely fine; performance is good, respectable, if a trifle stilted, but Wührer's technique is sure and strong. This agrees exactly with my previous hearings of his playing. An excellent bet and economical, too.

Mendelssohn: Violin Concerto in E Minor.
Tchaikovsky: Violin Concerto in D. Franciscatti; N. Y. Philharmonic, Mitropoulos.
Columbia ML 4965.

Our scout likes the Mendelssohn, especially in the last movement (and I'd expect Mitropoulos to do an outstanding job with the orchestra in Mendelssohn) but he thinks the Tchaikovsky's balance is poor—too much violin, the orchestra at a distance. This is the sort of disc-of-wooden chestnuts, I should add, that all too easily falls into routine virtuoso hackwork, in spite of top talent. They have to play the works so often, that the genuine feeling is desperately hard to invoke, on order.

Tchaikovsky: Violin Concerto in D. David Oistrakh; Saxon State Orch., Konwitschny.
Decca DL 9755.

One side for this on Columbia, above—a whole record here on Decca. Scout #1 calls the fiddling superb, which is what can be expected from this highly musical Russian. But the orchestra again is too distant, he says, and the recording is only adequate. If you collect Oistrakh (which is very worthwhile), try this one.

Tchaikovsky: Symphony #6 ("Pathétique"). N. Y. Philharmonic, Rodzinski. . .
Col. Entre RL 3118.

On Columbia's lower-priced label, this is a re-issue, together with numerous others, of the excellent recordings of the era just before LP, the originals, if I am right, having been wide-range 16-inch disc transcriptions—well ahead of their time in quality. Not up to current standards but ahead of much material from other companies from those days.

Scout #1 calls the Rodzinski recordings well organized, straightforward performances, without fancy tamperings for conductorial effect but on the whole a bit colorless; this is about the way I remember them from their original releases. He thinks that this one, the "Pathétique," is outstanding, one of the best versions, of any sort, on LP. Sounds like a very good bet.

Tchaikovsky: Serenade in C for Strings.
Prokofiev: Classical Symphony. RIAS Symphony, Fricsay.
Decca DL 9737.

Fricsay has been one of my favorite European conductors in many past recordings; when our scout reports that this is the finest version of the Serenade he's heard, I'm inclined to think—just what I would have expected. (He refers to another version, which I will tactfully leave anonymous, as "a seven-course dinner of whipped cream—ugh!")

The Prokofiev, he says, is surprisingly like the recent "Classical" by Ansermet on London records (which I liked a lot); a deliberate tempo in the first movement, tightening to a real "Russian" pace and strength in the finale. In both the orchestral recording is reported to be excellent with fine string tone. (A Deutsche Grammophon job.)

Tchaikovsky: Symphony #2 ("Little Russian"). Cincinatti Symphony, Thor Johnson.
Remington R 199-187.

This unusual little symphony will produce pleasure in many an ear that is jaded as far as the bigger and later Tchaikovsky symphonies are concerned. Not a "great" work and it has its typically noisy moments, but you'll find a youthful freshness in it, now and then, that is ingratiating.

Our informant thinks this one is musically not as free and supple as an old 78 rpm RCA version by the same orchestra under Goossens, but he prefers it to two Columbia versions, by Mitropoulos and Beecham. That sounds a bit drastic, I must admit (I'm *not* going out right now to test all three) but it poses a bit of a challenge to readers who can get to make their own comparisons. Sir Thomas B. is quite capable of being the prima donna on occasion, acting the coy eccentric—as he's equally capable of turning in a splendid and serious job on plenty of other occasions.

In any case (says Scout #1) this version has much the best recording, and I add that Remington, in spite of incredibly low prices, now is able to turn out a quality of sound that is easily competitive with more expensive discs. In particular I note that the early grainy hiss of the Remington material has now vanished; the background is as quiet as in many a higher-priced line, though whether the material is as durable I do not know.

Tchaikovsky: Sleeping Beauty Ballet.
 (a) Andre Kostelanetz and His Orch.
Columbia ML 4960.
 (b) Symphony Orch. of Radio Berlin, Guhl.
Urania URLP 7127.

Kostelanetz has been doing "classical" scores for some time now and the pattern has had time to set rather solidly. He has a high-priced orchestra and it performs in a high-priced way, that is, with perfect blend, as smooth as butter. No wrong notes in this ensemble. The resulting sound, with Columbia's fanciest recording, is invariably gorgeous—in fact it invariably sounds just like Kostelanetz.

A casual listener, therefore, is apt to be entranced, by such utterly polished music. I've been so myself. But on closer inspection there grows a certain tastelessness, a lack of character, a wood-

eness of expression which, in music of any subtlety is absolutely disastrous to the sense. (I'm reminded, for instance, of K.'s "Mother Goose Suite" by Ravel, which had a positively deadly polish to it.) It's not at all easy to detect, this soullessness, and I'm sure that the Kostelanetz readings sell mightily to plenty of folks who aren't too choosy about classical detail work so long as the over-all sound is as gorgeous as these recordings always are.

And so I can only concur when Scout #1, full of zeal, calls this a "dull, pedantic reading, the orchestral choirs out of balance—probably to get that thick Kostelanetz string tone," a concert-style performance with no heed paid to the danceability of the tempi. Again—about what I would expect.

The Urania, on the other hand, pleases him for its excellent dance tempi (which will be important for many dance-minded listeners and, incidentally, serve as a good indication of musical-minded playing) and the recording is relatively recent, with Urania's hi-fi "50-15000" imprint on its cover.

The orchestra, I take it, is that of *East Berlin*, whereas the RIAS is the Berlin Radio-in-the-American-Sector. On records the Iron Curtain is sort of plasticized.

BRAHMS

Brahms: Violin Concerto in D.

(a) D. Oistrakh; Saxon State Orch., Konwitschny. Decca DL 9754.

(b) Gioconda De Vito; Philharmonia Orch., Schwarz. His Master's Voice LHMV 5.

This would seem to be a case of an excellent recording and performance—the HMV version with De Vito—stacked up against the work of a violin genius—Oistrakh. Our scout calls the HMV version the better as to sound and says the Philharmonia's playing is good—in fact excellent (and all this in spite of the relative unfamiliarity of these names, too).

But Gioconda De Vito, of the operatic name, doesn't stand a chance next to the effortless strength of Oistrakh's performance. "Such sweetness of tone! Such cleanly articulated phraseology." She has worked out a good conception of this big work and she has plenty of temperament, he says, but her tone is harsh-seeming, her capacities strained, when she's compared directly to the fabulous Russian.

I've heard a bit of the Oistrakh myself and have listened to a number of his earlier recordings—Beethoven Kreutzer Sonata, a Mozart Concerto—with considerable wonder. Too often, these days, a new sensation like Oistrakh, plastered with all the high-powered publicity now available, turns out to be just another talented pusher, being pushed hard from behind by those who stand to gain. I'm frankly cynical about such matters. It seems to me that even the really great names (the ones, at least, who happen to get into the right situation, or have the right personality) often get pushed too hard, to their own detriment. It seems to me that the later Toscanini fame was of this sort. He was promoted relentlessly and still is. But his last recordings and performances were not his greatest.

And so, to conclude my own addition to this particular "review," I was honestly astonished to find that the famed Oistrakh really is a great violinist, and, at least in the sound, a modest, lyric, unaffected performer, rather than one of those mechanized powerhouses of technique that please so well these days. I'm all for him and I highly recommend his recordings, including this one.

Brahms: *Symphony #1*. N. Y. Philharmonic, Rodzinski. Col. Entre RL 3117.

Same general comments apply here as to the Tchaikovsky "Pathétique" reviewed above, but our scout isn't as enthusiastic about this performance. "Much like the superb Walter version on Columbia but without that one's blaze and impassioned accents." With this I would likely agree, since I found the Bruno Walter versions of the Brahms symphonies profoundly moving. Again, a reissue but with better technical quality than might be expected for its age.

Brahms: *Symphony #2*. Amsterdam Concertgebouw, Van Beinum. Epic LC 3098.

This one, says our informant, is "the peer of any of the 15 or 16 readings currently on the market" and splendidly recorded, too.

"It does not have the warm, passionate Roman-

Get the most for your money in quality

KNIGHT HIGH FIDELITY COMPONENTS



Knight "Bantam" Hi-Fi Amplifier

Compact—no cabinet required. Full 12 watts output; response, $\pm .5$ db, 20-20,000 cps; 3-position record compensation; loudness-volume control; tape recorder input and output jacks; microphone input; separate bass-treble controls; handsome black metal cabinet with etched gold trim, $3\frac{1}{2} \times 13 \times 10\frac{1}{4}$ ".

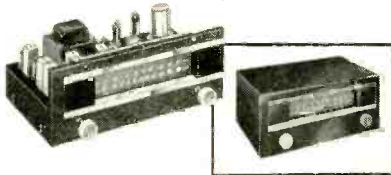
93 5X 312. Net only. \$59.50



"Golden Knight" 24 Watt Hi-Fi Amplifier

Brilliant performance: response, ± 0.75 db, 20-40,000 cps; less than 1% harmonic distortion at 24 watts; 3 positions of record equalization; separate bass and treble controls; 4 inputs; 8 and 16 ohms speaker output impedance. Rich satin gold finish, $8 \times 14 \times 9$ ". Removable escutcheon for custom panel mount.

93 5X 321. Net only. \$79.50



Knight FM-AM Hi-Fi Tuner

The ideal "space-saver" tuner. Highly sensitive drift-compensated circuit with AFC. RF stage on AM and FM. Loop for AM. Sensitivity: FM, 5 mv. for 20 db quieting; AM, 5 mv. Controls: tuning and selector, 10 tubes plus rectifier. Measures only $5\frac{1}{2} \times 13\frac{3}{8} \times 7\frac{1}{2}$ ".

94 5X 728. Net only. \$89.50

As above, but in black and gold metal cabinet, $6 \times 13\frac{5}{8} \times 8\frac{3}{8}$ ".

94 5X 729. Net only. \$95.50



Knight Self-Powered Preamp-Equalizer

Efficient, versatile control unit for any basic Hi-Fi amplifier. Response, ± 1 db, 30-30,000 cps; 3-position record compensator; 4 inputs; magnetic phono, tuner or crystal phono, tape, microphone; output, 2.5 volts; tape output, 1 volt; hum, -65 db. In compact black and gold metal cabinet, $3\frac{1}{2} \times 11\frac{1}{2} \times 5\frac{1}{2}$ ".

93 5X 315. Special Price Until Sept. 1, 1955. \$32.95

designed and built to ALLIED'S specifications

KNIGHT High Fidelity components give you the most for your money in performing quality, appearance and dependability. These units are designed and built to ALLIED'S own high specifications by outstanding makers of hi-fi equipment. Because these components are offered as ALLIED'S own private-brand products, large savings are passed on to you. KNIGHT quality is backed by an unconditional guarantee for one full year, and a 15-day trial offer with money-back guarantee. KNIGHT gives you the best Hi-Fi for less.

Knight System Value



"Space Saver II" Hi-Fi Phono System

Here's authentic Hi-Fi performance that fits in the smallest available space. No cabinets required. System includes: Knight 12 watt "Bantam" Amplifier, Webcor 3-Speed Changer (in Russet and Beige or Burgundy and Beige) with G.E. RPX-050 magnetic cartridge and dual-tip sapphire stylus; Electro-Voice "Baronet" enclosure with SP8-B speaker (in Mahogany or Blonde). Ready to plug in; hi-fi record included. Specify colors.

94 PA 159. Net only. \$157.95

FREE ALLIED'S 68-Page Hi-Fi Catalog

Your guide to a complete understanding of Hi-Fi. Shows you simply and clearly how to select a Hi-Fi music system at lowest cost; contains many handsome do-it-yourself instal-

lation ideas. Offers you the world's largest selection of complete systems and individual units (amplifiers, tuners, speakers, enclosures, changers, recorders, accessories) from which to make your money-saving choice. To understand Hi-Fi, to own the best for less, write for this FREE book.

ALLIED RADIO CORP., Dept. 17-G-5
100 N. Western Ave., Chicago 80, Ill.

Send FREE 68-Page Hi-Fi Catalog.

Ship the following: enclosed

Name

Address

City Zone State

ALLIED RADIO

America's Hi-Fi Center

Send for FREE Hi-Fi Catalog

TRANSCRIPT of Silence

the
**MIRACORD
XA-100**
record changer

The superb craftsmanship of the Miracord XA-100 permits only the recording, not the surface noise of the record, to reach your ear!

AVAILABLE
at all leading distributors
throughout the United
States

If you are interested in high fidelity you owe it to yourself to see and hear this remarkable instrument.



The Miracord XA-100 comes equipped with the "Magic Wand" spindle that preserves the life of your precious records.

Plus ALL THESE FEATURES

- No Wow.
- No rumble.
- Intermixes 10" and 12" records.
- Interchangeable plug-in heads.
- Ball-bearing-suspended turntable and tone arm.
- Adjustments without tools.
- Push button operation.
- Pausamatic — the user's choice of time lapse between records from 5 seconds to 5 minutes.
- Shipped complete with leads and plugs, ready to play.

**AUDIOGERSH
CORPORATION**

23 Park Place, N. Y. 7, N. Y.

ticism of the Walter reading, nor the kinetic vitality of Toscanini's, but it is as soundly conceived as either, better articulated, better balanced in the orchestral choirs." That would seem to sum up very nicely. He adds that the "celebrated Amsterdam brasses especially shine" and I add that this ought to make it a good bet for hi-fi, now that Epic's recording has risen up to top quality levels.

MAHLER

Mahler: Symphony #8 ("The Symphony of a Thousand"). Soloists, combined Rotterdam Choirs, Rotterdam Philharmonic, Flipse. (Holland Festival, 1954)
Epic SC 6004 (2).

Thanks be to our indefatigable Scout for ploughing through this monster! I did play a bit of it, but put the project off until I could find a long, relaxed evening—which will never come. I am an ardent admirer of Mahler when that real genius manages to confine himself to what in our times seems a reasonable discursiveness. But the big Symphonies leave me behind pretty quickly—though I bounce back again every so often at the superb moments which they all contain, moments that no other composer can equal.

This one was one of the vast attempts to carry music to Cosmic proportions that preoccupied Mahler in particular, as well as plenty of others in his day. (Remember that the Boston Jubilee festivals in the '70s brought together performing groups as large as 20,000 people—all going full blast at once! Those were the days before Public Address knocked the excitement out of Big Noise.) My scout feelingly describes this mammoth work for a mere thousand performers as "insufferably pretentious and interminably boring," which, I hasten to say, is an honest reaction that will apply to many listeners, whatever the "facts" may be! But, as he suggests, the work "has its admirers" and I am sure that it also has its wonderful moments, quite seriously, if patience can be summoned up to wait for them. He notes that this version, though inevitably fuzzy and blurred as might be expected with a mass of a thousand performers, is nevertheless superior to the Columbia version of awhile back from Vienna (SL-164), both in the recording and the performance.

But this isn't enough—our optimist scout goes on to suggest that Mahler fans might do well to "hold out for a more cleanly articulated sound," on some future recording yet to be made. *What!* With a thousand performers? Fine chance, is all I can say.

Somebody might try a bit of real hi-fi technique on the Symphony of a Thousand, to be sure. That is, 559 mikes, mounted every 5½ feet throughout the 1000 performers, chorus and orchestra, so that nobody, but nobody, would ever be more than coughing-distance from the nearest cardioid or condenser. Mix all 559 together (on some super-electronic mixmaster of a control board)—and you'd probably come out with the same old fuzzy blur all over again. Mahler knew what he wanted.

Of course another approach might be an arrangement, to adapt the music for better recorded sound. Say a recording ensemble of about ten voices and maybe sixteen instruments. Ideal. Mahler would turn in his grave, naturally; but if Mahlerites objected, as they probably would, then somebody would be bound to come up with the inevitable solution—run the whole thing through an electronic reverberation generator and make the ten-plus-sixteen players sound again like a Thousand. No sooner said than done! But—whoops! We'd be right back to that grand old blur again. Mahler really *did* know what he was doing and we might as well take it or leave it, via Epic's very reasonable version. It's a Thousand or nothing.

Mahler: Symphony #1.

- (a) Israel Philharmonic Orchestra, Kletzki.
Angel 35180.
- (b) N. Y. Philharmonic, Walter.
Col. SL 218.
- (c) Minneapolis Symphony, Mitropoulos.
Col. Entre RL 3120.

Mahler really gets around these days—here are three out of some nine versions available, as listed. To be sure, of the nine, one is conducted by Borsamski with the Radio Berlin Symphony (Vanguard) while another is by Borsamski with the Radio Berlin Symphony (Urania), but we mustn't

let petty duplications (?) like that bother us. Well . . . eight versions.

Except that two of them are by Mitropoulos and the Minneapolis, the old and expensive Columbia issue now being replaced gradually by the same performance, as above, on the cheaper Entre label. . . . Seven versions, then. Seven versions is still a lot.

Scout #1 is impressed by this first release from the Israel Symphony on Angel. He notes it as a performance "somewhat different in emphasis and general contours from the other releases, which are surprisingly alike in these respects" and though I am sure his judgment on the Angel is good, I beg to disagree, as per memory, concerning at least some of the other versions, those noted above.

The Mitropoulos Mahler First was one of the first records I remember reviewing, back around 1938 I'd guess. It was also my first crack at Mahler in any intimate way and I was crazy for the first movement and the second, though I never liked the "Frère Jacques" slow movement and still don't much, and thought the final coda, covering most of two 78 rpm sides, about the most hopelessly noisy ending I had ever experienced. Little did I know Mahler in those days!

The recent Bruno Walter version astonished me, because he tackled the long, slow, static introduction—static as Mitropoulos had it—in a remarkably different way. He made structural sense to me for the first time out of music that had seemed to me pure mood-stuff, though magical at that. A most interesting difference in approach, and I recommend a comparison to all who might be intrigued. I'd recommend both these, (b) and (c) above.

And perhaps, while you're at it, you'd better get the Angel version too. No point in stopping halfway. Our Scout calls the Angel sound "clear and quiet," which is an apt description of a recording technique not quite like anybody else's. He goes on to commend the Israel Orchestra's lovely string tone, which he describes glowingly as "a lamination of sweetness and expressiveness that is both distinctive and successful." That's a pretty high rating, I'd say.

FRENCH

Ravel: Piano Concerto in D (Left Hand); Piano Concerto in G. Jean Doyen; Lamoureux Orch., Fournet.
Epic LC 3123.

I was intrigued by Scout #1's account of this one and had to try it out myself—these two rich, wry, romantic, late-twenties concerti are favorites in my concerto book with their French urbanity, their powerful Ravel harmony and the fascinating glimpses of Gershwin and early jazz everywhere in them. (Ravel had met Gershwin in the United States and had been deeply impressed by his music as well as by the jazz he heard whenever he could.)

Our scout says this pair is preferable to the same on London with pianist Blancard and conductor Ansermet and, having heard both, I agree. The Ansermet version is beautifully tailored but curiously un-modern in approach, somehow denying the taut, tense quality of the music, so typical of Ravel and of the period, the end of the 1920's. It might be César Franck, as Ansermet conducts it.

The Doyen-Fournet combination, here, is more modern-sounding by far and César Franck isn't even in the offing. Yet I still have slight reservations—perhaps hair-splitting. I can't help feeling that here, too, there is a curious lack of that electric tension that I am sure is the essence of the music, beneath its suavity.

There's a reluctance to "push" on the wry, acute, bitter-sour Ravel melodic dissonances, so much like those of Gershwin, which abound in both concerti. These are "blue notes" in the exact jazzy sense, particularly fascinating in the context of Ravel's urbanely classic Gallicism. Somehow, Doyen and Fournet play them as if they weren't there, all smoothness and suavity. The avocado without the lemon juice. I'd call it.

* * *

Incidentally, the old story is here repeated, in the accompanying notes, that of these two concerti the Left Hand work is the jazzy one while the G major, for both hands, is "held tightly within its classical and traditional form." Bosh! Let me go on record as a minority of one who has always found the G major concerto the jazziest of the two, the bluesiest, and the best. Try it and see. A wonderfully revealing work and, blues or no, this performance will give you a plenty good idea of it.

Ravel: Bolero, La Valse, Valses Nobles et Sentimentales, Alborada del Gracioso, Pavane pour une Infante Defunte. Orch. du Th. Champs-Elysées, P. de Freitas Branco. Westminster WL 5297.

Ravel: Bolero, La Valse.
Honegger: Pacific 231.
Dukas: Sorcerer's Apprentice. The Paris Conservatory Orch., Ansermet. London LL 1156.

These two should have plenty of hi-fi appeal, for one thing. Our scout finds both brilliantly recorded, the Westminster "spectacularly so" (no doubt with Westminster's ultra-brilliant close-up technique of microphoning), the London "with better balance and fuller body." Both discs are well chosen collections of related hi-fi-style material, and those who know the respective Westminster and London styles of recording will hardly be disappointed in either case.

The two feature pieces on both. Bolero and La Valse, Scout #1 finds musically not too satisfactory: both feature slow tempi that, he feels, detract from the vitality and drama of these two *tour de force* of dramatic climax.

Debussy: Nocturnes for Orchestra (Nuages, Fêtes, Sirènes).

Ravel: Rapsodie Espagnol, Menuet Antique. Paris Conservatory Orch., Fournet. Epic LC 3048.

Scout #1 is full of enthusiasm for this disc and feels that these are "definitive" performances. He particularly likes the Ravel Rapsodie which he says has no equal on LP by a wide margin and makes a remarkable listening experience.

I might add that Fournet's work in other records I've heard recently would confirm this judgment; he is evolving into one of the best conductors of French music we have on records. The Scout speaks of the "distinctively Gallic sound of the horns" in the third movement of the Rapsodie—this, of course, would be due to the peculiar French-type instruments, quite unlike the ordinary "French" horns of other nations and played with a tell-tale vibrato, like a saxophone, where all other horns play without vibrato. The French-style horn playing is absolutely dreadful in Wagner or Brahms, but in French-composed music it is, needless to say, entirely natural and proper.

An adequate recording, not as fancy in sound as some competitive versions (Mercury, Angel)—this release dates from awhile back (last summer) before Epic had hit the hi-fi stride it now maintains. Get this one for the music, not the fi.

Franck: Symphonic Variations.

Fauré: Ballade.

Saint-Saëns: Piano Concerto #5. Jean Doyen; Magda Tagliaferro (Saint-Saëns); Lamoureux Orch., Fournet. Epic LC-3057.

Another Fournet-conducted disc and our scout again approves heartily. The Saint-Saëns, with pianist Tagliaferro, is well ahead of competition on M-G-M and Vox, he feels; the Franck and Fauré with Doyen at the piano benefit from the "fine idiomatic support" of the orchestra and Fournet. A first class musical offering in all respects, it would seem. (Indeed, I trust this account so well that I'm going to have to put the disc aside and play it anyhow—ghost or no ghost. I expect it to be a pleasure. There's nothing like French music well played.)

Recording, Scout says, is "good middle-period Epic." Readers will remember that this department called attention last year to Epic's initial difficulties with the new Phillips imported recordings and prophesied that things would soon improve. They have and Epic is out in front soundwise this year. The present disc dates from the end of last year when things were beginning to go well technically—hence, "good middle-period."

Offenbachiana (adapted and orchestrated Rosenthal). RIAS Symphony, Rosenthal. Remington R-199-183.

Offenbach-Rosenthal: Gaité Parisienne.
Chopin: Les Sylphides. Philadelphia Orch., Ormandy. Columbia ML 4895.

Three ballet scores adapted from 19th century works not originally ballet-intended, but two of

them, at least, are so well known now as to be more famous in the ballet form than in the original. Ballet suites of this sort have had wide popular success as musical numbers (minus the ballets) and so it's not surprising that Manual Rosenthal has tried to follow up the phenomenal success of his "Gaité Parisienne" with another from the same composer.

"Lightning seldom strikes twice" is Scout #1's succinct comment on the Remington "Offenbachiana," above, that is the result. He thinks it of little interest, though the playing is "live and bouncy" with nice orchestral coloring. In all truth, Offenbach wrote some pretty thin stuff to pad out the relatively few bits of really fine music in his enormous output of opera. It takes a very careful search to come up with music as consistently good as "Gaité Parisienne."

As to "Gaité" itself, on Columbia, Scout reports it is a fast, virtuoso concert performance, over-brilliant. This, I'd say, is what usually happens when a top virtuoso orchestra takes up a popular light item and makes a big thing of it.

"Sylphides," he says, has a fine string sound (it's predominantly a string piece, arranged from the piano originals) not too heavy and beautifully recorded.

SUSPENSION SPEAKER

(from page 20)

figure of merit a strange correlation could undoubtedly be made between the features of a particular manufacturer's speaker and the qualities emphasized as most important to the figure of merit. Manufacturers of low-efficiency speakers would tend to deny the relevancy of efficiency, while manufacturers of high-efficiency speakers would probably take an opposite stand.

At the risk of the writer's seeming to have an ax behind his back in need of grinding, it is submitted that efficiency should not appear in the main term of a figure of merit for loudspeakers, but in a second term connected by a plus sign. The second term would include other factors such as price and size. Low efficiency simply means that for given performance results more money, weight, and space must be invested in amplifying equipment. The relative cost, in terms of these three factors, of the added electronic capacity can be calculated, but should not be reflected in the index of quality.

In the case of the Acoustic Research woofer, efficiency has been deliberately traded for extended and uniform bass response and low distortion. It is obvious that the magnetic circuit used in the AR woofer is sufficient for a motor of very high efficiency. The sacrifice of efficiency is justified, in the mind of the writer, by the performance data reported in this article.

High-Frequency Speaker

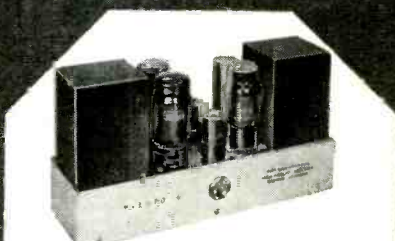
The high-frequency speaker used in the model AR-1 system is an 8-inch direct radiator. Its performance characteristics, as used in the system with a 12 db/octave bass-droop network and pad, and as measured by Acoustic Research, are: frequency response 800—13,000 cps ± 5 db, and distortion over above range with 10 watts input, 1 per cent maximum.

HIGH FIDELITY



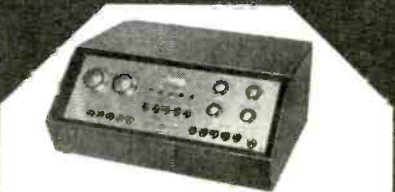
AF-860 A M-FM PILOTUNER
 The Ultimate in engineering skill and sensitivity — symbolic of the complete line of superb Pilotuners.

PILOTUNERS



AA-904 PILOTONE AMPLIFIER
 World famous Ultra-linear Williamson circuit — an electronic triumph characteristic of the wide range of Pilotone Amplifiers.

PILOTONE AMPLIFIERS



PA-913 PILOTROL
 Professional Preamp Equalizer, an innovation in audio control—and other fine products, including the portable Encore; reflect the Pilot "Standard of Excellence."

FOR TECHNICAL DATA AND BROCHURE, WRITE TO:

Pilot
RADIO CORPORATION

37-06 86th Street
 Long Island City, N. Y.



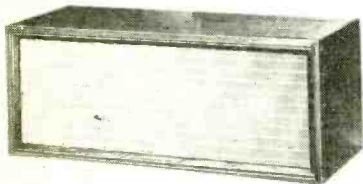
NEW PRODUCTS

● **Heathkit Harmonic Distortion Meter Kit.** Heathkit's new Model HD-1 kit is inexpensive to build and simple to operate, yet performs most of the functions of more elaborate audio distortion testing instruments. Used with a sine-wave generator it will check harmonic distortion of signal generators, audio amplifiers and similar



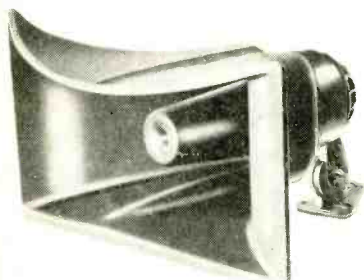
devices. Frequency response is 20 to 20,000 cps in three ranges. A VTVM circuit is used for initial reference settings and final harmonic distortion readings. The HD-1 has high-impedance input and requires only 0.3 volt for distortion tests. Further information may be obtained by writing to The Heath Company, Benton Harbor, Mich. **L-1**

● **GE Eight-Inch Speaker Enclosure.** Although designed primarily for use with the GE Model 850 extended-range 8-in. speaker, the new Model A1-411 enclosure is equally effective when used with other speakers with similar characteristics. Recommended for extension applications or where space limitations prevent using larger speakers in high-fidelity music systems, the enclosure affords an internal volume of 1.2 cu. ft. and measures 26"l x 11" d



x 10" h. It is of the "distributed-port" type with half-inch acoustic lining. The speaker opening is concealed behind a Lumite cloth grill which covers one entire side of the enclosure. Because all four sides are finished, the unit can be mounted in any desired position. By adding legs of wood or wrought iron, it can be used as a console. General Electric Company, Electronics Park, Syracuse, N. Y. **L-2**

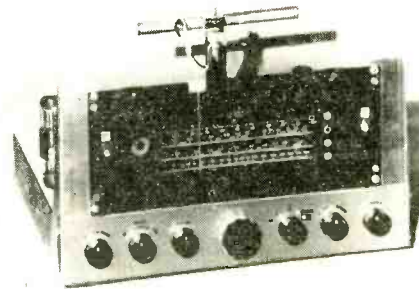
● **University Paging, Talk-Back Speaker.** Exceptionally wide horizontal dispersion is afforded by a new concept in wide-angle



speaker design recently introduced by University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y. The Model CIB

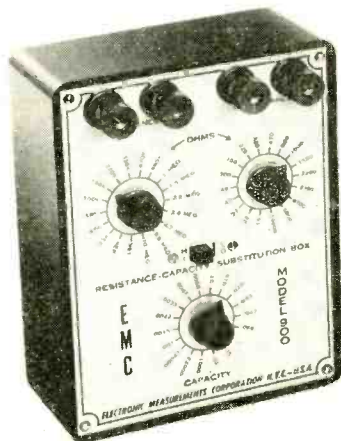
comprises a built-in hermetically-sealed driver unit assembled to a reflex air column terminating in a cobra-shaped wide-angle bell. The bell is a one-piece mold of Fibreglass-reinforced polyester resin which is strengthened with a full-length steel bead. The driver unit is treated with an anti-fungus compound for complete weatherproofing. All exposed metal surfaces are electro-chemically plated against corrosion and are finished in gray peel-proof baked enamel. The CIB is rated at 12 watts continuous duty with a response of 300 to 13,000 cps. Horizontal and vertical dispersion are 120 and 60 deg., respectively. The Model CMIL is of similar construction to the CIB except that a screw-in driver is used. It is rated at 3 watts continuous duty with a response of 400 to 13,000 cps. Free illustrated brochure will be mailed on request. **L-3**

● **Hi-Fi International AM Tuner.** Both standard broadcast and short wave bands are covered by the new Series 2100 tuner now available from Scott Radio Laboratories, Inc., 1020 N. Rush St., Chicago 11, Ill. Tuning range is 540 to 20,000 kc in three bands. Unique features include vari-



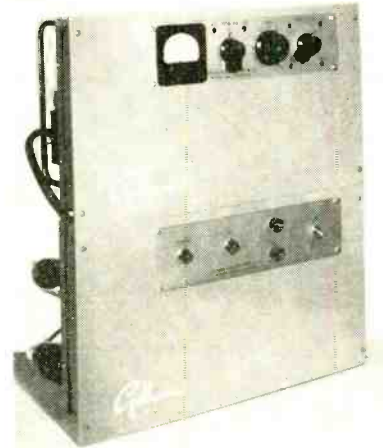
able selectivity controls, noise limiter circuits, and wide-range audio amplifying circuits for exceptional AM frequency response. The Series 2100 tuner is available both as a separate chassis and incorporated in complete Scott radio-phon-TV instruments. A new bulletin containing full technical and performance specifications will be mailed on request. **L-4**

● **Resistance - Capacitance Substitution Box.** This instrument, available fully wired or in kit form, provides 36 standard RETMA resistor values ranging from 15 ohms to 10 megohms, and 18 capacitance values from .001 to 22 mfd. Accuracy is within 10 per cent. It is well-suited for determining proper values in the design of R-C circuitry, also for learning the



original values of charred or unmarked resistors and capacitors when servicing equipment without a schematic diagram. Designated Model 900, the unit is manufactured by Electronic Measurements Corporation, 280 Lafayette St., New York 12, N. Y. Complete technical details are available on request. **L-5**

● **Disc Recording Power Amplifier.** Power output of 150 watts with less than 0.7 per cent rms harmonic distortion from 40 to 15,000 cps is characteristic of the new recording amplifier recently announced by Gotham Audio Development Corp., 2



W. 46th St., New York 36, N. Y. At 10-watt output distortion is less than 0.15 per cent from 20 to 20,000 cps. Intermodulation is held below one per cent at rated power output, while damping factor exceeds 40. Instantaneous peak power of 400 watts is available with complete stability. Noise level is 72 db below 10 watts output. Balanced and unbalanced inputs ranging from 150 to 10,000 ohms are available, while output impedances range from 8 to 33 ohms. A gain control adjustable in 2-db steps and direct output-tube plate metering are provided. The amplifier proper consists of six push-pull stages balanced through use of one-percent-tolerance precision resistors. Output tubes are 811-A's biased positively for minimum distortion. The unit will accommodate every cutter head made for disc recording, including the British-made Gramplan for which feedback connections have been provided. Built for standard rack mounting, the unit occupies 21 ins. of vertical panel space. Further information on request. **L-6**

● **Extended-Range Voltmeter.** Both portability and precision are inherent in the improved version of the Model 520-A voltmeter manufactured by Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y. Performance as voltmeter, null indicator, and



60-db decade amplifier is independent of line-voltage interference and external stray fields to an excellent degree. The unit operates on power-line frequencies from 50 to 400 cycles. Full-scale sensitivity of 1 mv permits measurements as low as 100 microvolts. Ranges are provided up to 300 volts, as well as from -72 to +52 dbm. Frequency response as a voltmeter is from 10 cps to 2 megacycles, and as a null indicator from 5 cps to 4 megacycles. The instrument may be carried in a standard briefcase and weighs only 6 lbs. **L-7**

(Continued on page 46)



HARVEY the House of Audio

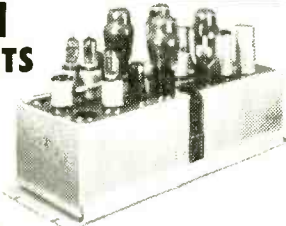
McINTOSH HIGH FIDELITY UNITS

50 Watt AUDIO AMPLIFIER
Model 50 W-2

A novel and unique circuit design is employed to provide 50 watts of continuous power (100 watts peak) with amazingly clean, distortion-free reproduction. Frequency response extends from 20 to 20,000 cycles, ± 1 db, and from 10 to 100,000 cycles, ± 3 db. Distortion is less than 1% over the entire audible spectrum at full 50-watt output. Phase shift is negligible. High damping factor and other features contribute much to the outstanding listening quality of the 50 W-2.

Complete with tubes.

\$249.50



PROFESSIONAL AUDIO COMPENSATOR AND PREAMP Model C-8

A complete, flexible front end unit with 5-position selector switch for AM, FM, Phono, Microphone, TV, Tape or other program sources. Has a built-in variable rumble filter. Five sliding-switch, turnover controls used individually or in combination permit up to 11 turnover settings from 280 to 1340 cycles. Another series of five sliding switches allow up to 11 treble roll-off curves. There is a volume control plus a 5-position compensator which maintains bass and treble balance at low levels. A variable input resistor, calibrated from 1K to 100K ohms, terminates any magnetic cartridge, with correct load for optimum performance. A switch provides equalization for FM or ceramic cartridges. Power is obtained from the main amplifier or from separate power supply as listed below.

- C-8M with tubes in attractively styled cabinet. **\$96.50**
- C-8PM — As above, with auxiliary power supply. **107.50**
- C-8 — with tubes, less cabinet. **88.50**
- C-8P — As above, with auxiliary power supply. **99.50**

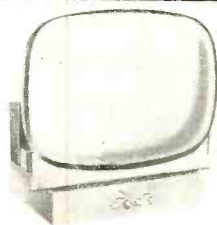


COMPONENTS Professional 3-SPEED TURNTABLE

A high quality record turntable with extremely low rumble and wow content. Employs a constant speed, shielded induction motor, double shock-mounted to isolate vibration. An endless fabric belt drives the turntable directly from the motor shaft. Speed change is made by placing the endless belt on the proper pulley step.

The turntable itself is a 25-pound steel disc with a polished steel shaft riding on a ball thrust bearing. An expanding spindle is used which automatically centers the record. The entire turntable assembly is mounted on damped coil springs to absorb floor and cabinet vibration. The table provides ample room for mounting a pickup arm.

- Blonde or Mahogany **\$99.50**
- Base Skirt (as shown in illustration) **15.00**



CONRAC Fleetwood REMOTE CONTROL TELEVISION RECEIVER CHASSIS Models 600 and 700

Two-chassis, remote control TV receivers designed for custom installations. Circuit employs 27 tubes, exclusive of picture tube. Audio amplifier supplies power for existing speaker, also low level high impedance and cathode follower outputs to feed complete sound system. Remote tuner embodying all controls can be operated 40 feet or more from picture chassis. Supplied complete with tubes, but less picture tube, mounting bracket and cabinets.

- Model 600—for 21" (70°) rectangular picture tube **\$264.50**
- Model 700—for 24" and 27" (90°) rectangular picture tube **289.50**

NOTE: These receivers may be obtained with self-contained controls on single chassis (without remote tuner): Models 610 and 710, priced at \$199.50 and \$219.50 respectively.

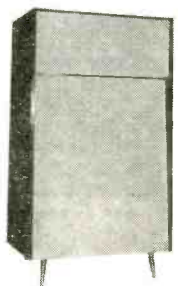
- Cabinet for Remote Control Unit
- Mahogany or Walnut **\$19.95**
- Blond or Maple **21.95**
- Unfinished **16.95**

Where no cabinet facilities are available to the user, Mounting and Accessory Kits are supplied suitable for wall-type and similar installations. Complete literature furnished on request.

HARVEY IS NOW AN AUTHORIZED DISTRIBUTOR OF

Stan White SPEAKER SYSTEMS

Only At HARVEY'S
Can You See and Hear
The 4-D Super System
In Stock and Available
for Immediate Delivery



The 4-D Super System

A speaker system of unusual performance and presence. Can be operated at tremendous power with perfect clarity in large halls and auditoriums. The power handling capacity of the entire system is in the order of 120 watts.

Four loudspeakers are employed to operate as a 3-way system: (2) 15-inch bass drivers with 4" voice coils cover the 15 to 600 cycle range; (1) 30 watt horn driver covers 600 to 2000 cycles and (1) high frequency horn driver extends the system coverage to 16,000 cycles. The impedance of the entire system is 16 ohms. The cabinet measures 67x40x24". Shipping Weight is 400 lbs.

Complete **\$150000**

The 4-D Standard System

A 3-way system similar in performance to the 4-D Super System, but with lower power handling capacity (60 watts) and intended for deluxe home music systems. A single 15" bass driver is used together with a mid-frequency horn driver and a tweeter to provide a frequency response from 40 to 16,000 cycles. Impedance is 16 ohms. Cabinet dimensions are 67 x 36 x 24". Shipping weight is 350 lbs.

Complete **\$99400**

The HI-FI Model 4830

Provides a substantially flat frequency response from 20 to 16,000 cycles. Peak power handling capacity is 50 watts. Employs (2) 8" woofers, one horn mid-range driver and one horn tweeter. Impedance is 16 ohms. Dimensions: 55 x 30 x 20". Shipping weight: 220 lbs.

Complete **\$64500**

The ESQUIRE Model 3424A

A 2-way speaker system providing response from 30 to 16,000 cycles. Employs (2) 8" drivers covering 30 to 2000 cycles and a high frequency horn driver operating from 2000 to 16,000 cycles. Power capacity is 25 watts and impedance 16 ohms. Dimensions: 36 x 24 x 16". Shipping weight: 60 lbs.

Complete **\$19400**

The Le SABRE Model 2415

An apartment sized 2-way system employing an 8" bass driver and a 5" tweeter. The bass horn is effective down to 50 cycles and the tweeter radiates up to 16,000 cycles. Power handling capacity is 14 watts and impedance is 8 ohms. Dimensions: 24x15x12". Shipping weight: 22 lbs.

Complete **\$7950**

The Le PETITTE Model 1911

A 2-way system ideal for restricted space use. Flared horn is effective to 60 cycles. Employs an 8" bass driver and a 3" tweeter. Power capacity is 14 watts and impedance 8 ohms. Dimensions: 23 x 13 x 10". Shipping weight: 19 lbs.

Complete **\$4950**

All Stan White Speaker Systems employ multi-flare exponential horns providing effective speaker loading and acoustical coupling with air to extremely low frequencies. The multi-flare horns are curled into the cabinet. All cabinets are available in blond korina, walnut, mahogany and ebony finishes. Models 2415 and 1911 are equipped with wrought iron legs, all others come with satin finished brass legs.

AMPEX 600 PORTABLE TAPE RECORDER

A high quality tape recorder designed for professionals: broadcasters, recording studios, and other critical users. Weighs less than 28 lbs. Identical in performance to the console model 350. Has separate erase, record and playback heads, also record amplifier and separate playback amplifiers with 1.25 volt output. Meter permits continuous checking of recording level. Tape speed is 7 1/2 inches/sec. with a frequency response from 40 to 10,000 cycles ± 2 db and to 15,000 ± 4 db.

Complete with tubes, less microphone **\$54500**



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

HARVEY RADIO COMPANY, INC. ESTABLISHED 1927
103 W. 43rd Street, New York 36 • JU 2-1500

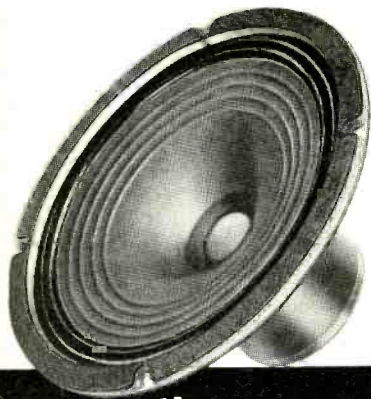
Especially

where

space

is

limited



the
GOODMANS

Axiette
8 inch
HIGH FIDELITY
LOUDSPEAKER

MADE IN ENGLAND

ROCKBAR CORPORATION, Dept. LG-1
215 East 37th St., New York 16, N. Y.

Please send complete description of the
Goodmans Axiette.

Name

Address

City Zone State

My Dealer is

PATENTS

(from page 2)

be moved from side to side (in the same plane as the tape movement) by motions of the solenoid plunger.

If the tape is running slow, the polarity of the d.c. put out by the balanced modulator is such as to cause the solenoid plunger to move to the left—opposite to the direction of tape travel. The plunger pulls the head with it. This results in increased velocity of tape travel with respect to the head and tends to correct the slowness. For fast tape speed the polarity is such as to move the head in the same direction as tape travel, reducing the effective tape speed with respect to the head. When the tape speed is correct, the head is held in center position by a pair of balanced springs (not shown in the drawing).

This part of the system takes care of small, fast speed variations such as might cause wow and flutter. The head is sufficiently small and light and the power of the solenoid sufficiently high so that head motion is prompt and fast enough to iron out these small variations in speed. Head motion of more than about 0.1 in. is not usually necessary.

To take care of larger variations and those which are alterations of average or over-all tape speed, the system is extended. On the other side of the playback head a rigid mechanical linkage is connected to (but insulated from) the center arm of a s.p.d.t. switch. The switch is connected to a small motor whose shaft turns the arm of a rheostat in series with the capstan drive motor. The capstan drive motor is not synchronous and its speed may be varied by this rheostat. In center position, the rheostat sets the capstan motor speed at about the normal value. The rheostat motor is reversible and the direction it takes is determined by which of the outer arms the center switch contact strikes.

If the tape speed is slower than it should be, the solenoid plunger pulls the head toward it. The head pulls the center switch arm over to contact the left contact. This energizes the rheostat motor so that its shaft turns the potentiometer counterclockwise, increasing the voltage on the capstan motor and advancing its speed. As the tape speed increases toward normal, the tell-tale d.c. emerging from the balanced modulator

decreases, allowing the playback head to return toward center. When the tape speed is correct, the playback head completes its return to center, the switch opens, the rheostat stops rotating, and the voltage on the capstan motor is correct.

As stated earlier, the important feature of this invention is the playback head movement. Average speed correction could be taken care of simply by energizing the rheostat motor from the modulator output. However, the rotor of the capstan motor has a relatively high inertia, meaning that speed correction takes an appreciable time; as a result, sudden speed variations cannot be ironed out in this way and, even more important, because the corrective effect on the capstan motor takes time there would be an appreciable interval between detection of the error by the modulator and completion of the correcting action, during which speed would remain incorrect and synchronization would be lost. With the present system, the two more or less separate mechanisms operate, one correcting small, fast errors, and the other correcting average error.

There are two advantages to the choice of a low frequency like 60 cps for the timing oscillators rather than one at perhaps 15,000 cps, even though both are outside the band normally used in motion-picture work. First, it is probably easier to keep the timing oscillators in both recording and playback equipment on the same frequency, since they can easily be made subject to injected synchronization voltage from the line in such a way that they are locked to the average line frequency (without being subject to the short-term line-frequency variations). But second and more important, the synchronous motor of the film projector may be operated from a power source synchronized to the timing oscillator in the playback system. This ties the projector and the playback machine solidly together. Then if the playback timing oscillator frequency is a bit high or low with respect to that of the recording oscillator, causing the tape to go somewhat faster or slower than when it was recorded, the film projector speed will increase or decrease by the same percentage, maintaining perfect lip synchronization between sound and motion.

A few further details, mostly mathematical in nature, are given in the patent which, for 25 cents and a note of the number, you can obtain from The Commissioner of Patents, Washington 25, D. C.

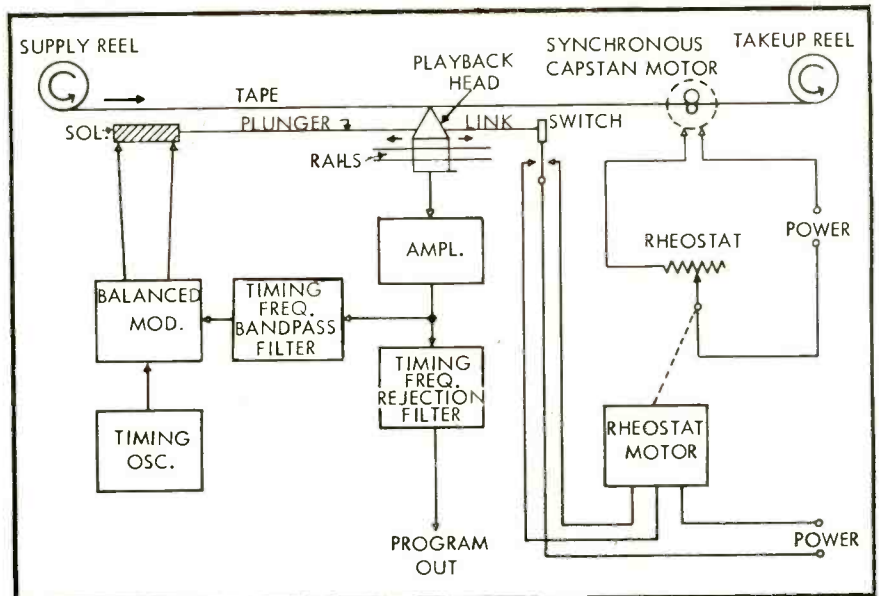


Fig. 2

AUDIO ETC

(from page 28)

of the problematical future. It would seem to me to be the most important factor of all.

Anyhow . . . in "Deserts," Varèse places his orchestra of live musicians square in the middle of things, as described above, with the loudspeakers to each side. The sound must be big enough from the speakers to outblast a fabulously potent direct hitting power in the live orchestra. Don't underestimate the "sock" of twenty musicians equipped with the fire power Varèse here assembles! 100 clean watts of audio is just about adequate to provide a good "balance" (i.e., the live musicians outblasted by the recorded sound), with a bit left over for distortion leeway.

"Deserts" begins with the orchestra. For many long minutes the intensity of percussion, brass and screeching woodwinds (hanshee clarinets, steampipe flutes in an ultra-high register) builds up, until—the suspense having become intolerable—the whole is suddenly drowned out by the first entrance of the taped sound, like some vast double-concerta with a pair of soloists. Roars from the left and, as the audience craned necks to see where it was coming from (more on this in a moment), an answering roar from the far right; then a steady counterpoint of percussive rhythms, enormous, low-pitched groans, huge industrial grunts like dinosaurs ten times magnified. Sometimes both tracks were going at once, for the climaxes, sometimes there were long "solos" for one track at a time.

And after many an extraordinary minute of this dual sound-parade, with audience and orchestra alike absorbed and horrified by this gigantic powerhouse of organized noise—a quick eye could catch Ann McMillan's hand going up behind the Ampex to throw a radio-style cue and Mr. Waldman's hand going up in response, for a conductor-style cue to the instruments; and in the smoothest way imaginable, the orchestra comes in with a blast of new sound as the tape echoes away. The second A section is upon us.

Varèse points out that as the intensity of expression increases, the length of the opposing sections decreases, for a kind of *stretto* effect, a piling up of hitting-power. The over-all growth and subsidence of this intensity becomes very apparent on the second or third playing and the more you hear, the more impressive is the sense of shape and drama and climax that assails you.

At the end of a near half-hour of this highly organized bedlam you are reduced to a state of ninth-inning exhaustion or exaltation—no matter which it is (and you're not likely to be any too sure, for that matter). The variety of sound is enormous, the interest never lags, the drama is expertly sustained, and, most interesting of all, the unity of material becomes more and more evident.

Is it music? That's an inevitable question. The Varèse answer is as simple as pie.

You'll note I haven't spoken yet of "Deserts," as music. That is because Varèse doesn't either. He both dodges that highly theoretical question and explains the piece in one phrase. He calls it "organized sound."

Music, after all, is organized sound. The greatest music is sound with an extraordinarily potent and subtle degree of organization. Sound that is random, unorganized, is certainly *not* music. Not good music, anyhow.



Build it
YOURSELF

Heathkit HIGH FIDELITY PREAMPLIFIER



MODEL WA-P2

Here is the complete preamplifier. Designed specifically for use with the Williamson Type circuit, it provides equalization for LP, RIAA, AES, and early 78 records, 5 switch-selected inputs with individually preset level controls, separate bass and treble tone controls, special hum control, etc. Outstanding in performance and most attractive in appearance. Fulfills every requirement for true high fidelity performance. Shpg. Wt. 7 lbs. **\$19.75**

Heathkit WILLIAMSON TYPE 25 WATT AMPLIFIER (PEERLESS TRANSFORMER)

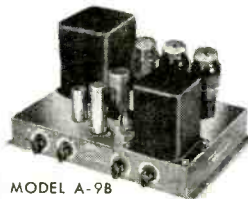
This latest and most advanced Heathkit hi-fi amplifier has all the extras so important to the super-critical listener. Featuring KT-66 tubes, special Peerless output transformer, and new circuit design, it offers brilliant performance by any standard.

Bass response is extended more than a full octave below other Heathkit Williamson circuits, along with higher power output, reduced intermodulation and harmonic distortion, better phase shift characteristics and extended high frequency response. A new type balancing circuit makes balancing easier, and at the same time permits a closer "dynamic" balance between tubes.

Aside from these outstanding engineering features, the W-5 manifests new physical design as well. A protective cover fits over all above-chassis components, forming a most attractive assembly—suitable for mounting in or out of a cabinet. All connectors are brought out to the front chassis apron for convenience of connection.

Model W-5M consists of main amplifier and power supply on single chassis with protective cover. Shpg. Wt. 31 lbs. **\$59.75**
Express only
Model W-5 consists of W-5M, plus WA-P2 Preamplifier shown on this page. Shpg. Wt. 38 lbs. **\$79.50**
Express only

Heathkit HIGH FIDELITY 20 WATT AMPLIFIER



MODEL A-9B

This particular 20 watt Amplifier combines high fidelity with economy. Single chassis construction provides preamplifier, main amplifier and power supply function. True hi-fi performance ± 1 db, 20 cps to 20,000 cps. Preamplifier affords 4 switch-selected compensated inputs. Push-pull 6L6 tubes used for surprisingly clean output signal with excellent response characteristics and adequate power reserve. Full tone control action. Extremely low cost for real high fidelity performance. Shpg. **\$35.50**
Wt. 18 lbs.

HEATHKIT High Fidelity "BUILD IT YOURSELF" amplifier kits

Heathkit WILLIAMSON TYPE (ACRO-SOUND TRANSFORMER)

This dual-chassis high fidelity amplifier kit provides installation flexibility. It features the Acrosound "ultra-linear" output transformer, and has a frequency response within 1 db from 10 cps to 100,000 cps. Harmonic distortion and intermodulation distortion are less than .5% at 5 watts, and maximum power output is well over 20 watts. A truly outstanding performer. W-3M consists of main amplifier and power supply. Shpg. Wt. 29 lbs., Express only. **\$49.75**

Model W-3 consists of W-3M plus WA-P2 Preamplifier listed on this page. Shpg. Wt. 37 lbs., Express only. **\$69.50**

Heathkit WILLIAMSON TYPE (CHICAGO TRANSFORMER)

This hi-fi amplifier is constructed on a single chassis, thereby affecting a reduction in cost. Uses new Chicago high fidelity output transformer and provides the same high performance as Model W-3 listed above. An unbeatable dollar value. The lowest price ever quoted for a complete Williamson Type Amplifier circuit.

Model W-4M consists of main amplifier and power supply on single chassis. Shpg. Wt. 28 lbs., Express only. **\$39.75**
Model W-4 consists of W-4M plus WA-P2 Preamplifier. Shpg. Wt. 35 lbs., Express only. **\$59.50**

COMBINATION
W-5M and WA-P2



HEATH COMPANY

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 25,
MICHIGAN

Write FOR FREE CATALOG AND SCHEMATICS

Listening Quality is everything!

CHROMATIC HI-Q7

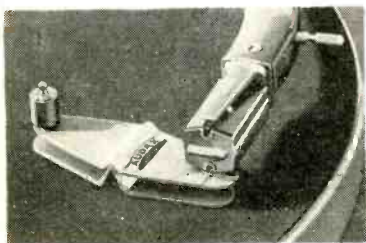
Today, all pickups good, bad or indifferent, have wide frequency range, yet one will perform smoothly, while the others are harsh, shrill, etc. The NEW high output HI-Q7 has BALANCE, SMOOTHNESS, LISTENING QUALITY, not equalled by any other pickup. . . . But—all the flowery specifications in the world cannot change the fact that ONLY you can tell what sounds best to you. Hear and compare the HI-Q7 with any other pickup known and—you be the judge.



Plays all speeds. Equipped with Chromatic DIAMOND and a sapphire stylus—both replaceable AT HOME.

NEW COMPASS-PIVOTED ARM

Universally acknowledged as the most efficient arm—barring none. No restraint • No frontal oscillations • No springs • No fatigue • Highest tracing efficiency. Equipped for stylus-pressure adjustment. New adapter makes this superb AUDAK arm useable with practically all cartridges.



STYLUS-BALANCE

“... this really works ...” Canby

75% of the cartridges in use, work with incorrect stylus-pressure. This means stylus and record destruction. With the scales and gauges available heretofore, it has been impossible to check stylus-pressure closer than 2 or 3 grams—one way or the other. That is 50% off-correct. This means deformation of groove-walls, which explains much of the echoes, ghosts and other distortion. Stroboscope-like, STYLUS-BALANCE accurately indicates correctness or incorrectness of stylus-pressure. Works with any arm and cartridge.

Net \$4.80 . . . Add 25¢ if shipped from N. Y.

FREE copy of “ELECTRONIC PHONO FACTS” at your dealers, or write us.

AUDAK COMPANY
500 Fifth Ave. Dept. A New York 36

Fine Audio-Electronic apparatus over 30 years

To be sure, Varèse's organization is not of the sort familiar to our ears in “conventional” organized music. If you wish to reserve the sacred term “music” for other types of organization than his, you are entirely free to do so and Varèse will not be disturbed in the least. But if you dare call his work disorganized, you're in for an explosion of temperament, and disorganized it certainly is not!

The Orchestra

Let me go back for a look at the ingredients of “Deserts.”

At the back of the stage holding the live musicians was the assembled wind and brass potential. Three trumpets, three trombones, three horns, plus two clarinets and two flutes, and on the tonal bottom, a pair of huge tubas. If you've ever stood directly in front of a solid trumpet blast or a trombone salute, you know what sort of audio power this means, and Varèse (unlike some other type composers) is first of all a master at the art of orchestration. He gets the d—dest noises you ever heard out of these supposedly conventional instruments, not only the brass but also those banshee clarinets and steampipe flutes. No strings, too weak.

Along with the brass is a huge concert grand piano, top open, on which trip-hammer chords are played percussively “as an element of resonance.”

The simple word “percussion” covers, in “Deserts,” about a dozen noise-makers per man, as far as I could see. There were, of course three ordinary typani (tunable drums) plus a big bass drum, and a battery of xylophone-vibraphone contraptions to fill in the spaces around the drums. No milk bottles and steel sheets here, as in “Ionisation,” but there was an assemblage of a couple of hundred odd blocks, rattles, gourds (to be scraped or rasped), whips (that sound like rifle shots) and, of course, the aforementioned pair of leather cushions and the paddles to beat them with. When all of this was going at once, the musicians sprang hither and yon like so many agitated monkeys, reaching over and around and under each other to whack this or that instrument with one hand while the other reached for a different one.

Granted that most modern percussion playing takes on this Jungle-Jim aspect. Percussion players have to be part monkey to begin with. But it was really hard to believe that such incredibly complex sound-mixtures and rhythms and textures could be reduced to conventional written musical notation, let alone imagined ahead of time by the composer. Yet every man had his sheet of music and (generally speaking) the sounds were indeed the same each time the thing was played.

Again, if you will play “Ionisation” on the hi-fi turntable and “Intégrales” on another and mix the two together, you'll have a passable idea of the general sound of the “Deserts” orchestra. The idiom is easily similar to that of the early Varèse of the Twenties but with a more densely concentrated effect. And, remarkably enough, it seemed to me there was a very clear sense here of greater maturity, of more poised and meaningful expression. Not easy to believe, but it hit me quite forcefully and I'm sure it would any reader who had a chance to get familiar with Varèse, both early and late. It takes a long lifetime of experience and a lifetime's accumulation of wisdom and knowledge to “compose” sounds as expertly organized as these.

The Tapes. . . .

But this was merely the A sound of Deserts, the orchestra. What of the tapes?

As I have suggested, the consistency of sound between the orchestral and the taped parts was quite astonishing, considering their different origins. To be sure, Varèse used a certain number of taped common orchestral sounds, suitably processed and altered via tape trickery, to add cohesion and unity when mixed with the factory noises. But a casual ear would have had a tough time picking out the “musical” noises from the industrial ones, so ingenious is the blend. I didn't begin to recognize vylophone notes and the like among the taped effects until I'd heard the tapes a number of times over.

But what one does hear quickly is an actual “thematic” resemblance between sound-clumps—so to speak—in the taped and live portions. A certain heavy groan, of a giant drill or saw, that appears numerous times in numerous forms in the taped sound suddenly identifies itself as related to a certain blast of French horn sound that comes near the beginning of one of the orchestral sections. The similarity grows upon repetition, just as theme-relationships dawn upon one and grow more certain each time we hear a work of “ordinary” music.

After awhile, you begin to realize that all of this vast Varèse wattage of industrial audio comes basically from a finite and not-too-large number of audio “ideas”—themes, fragments, motives, whatever you may call them. These in fact are the basic materials, and they came each from a short piece of original tape. How many hundred miles of tape Varèse “exposed” inside his chosen factories I do not know. But by some inscrutable boiling-down process possible only in his own mind these few cogent sounds were picked out of the rabble, none of them more than, perhaps, a dozen feet in length, for the raw material of organization.

The technological key to most of Varèse's “organizing” of taped sounds, aside from the inevitable copying and recopying and combining, would seem to lie in a unique sort of tape player available in Europe and (I understand) not to be found hereabouts, a variable-speed machine that can change speed almost instantaneously in steps, or in slow fire-siren style, over a wide range of frequency, an octave or more.

On this machine a given sound-clump may be used to “play a tune” right up the musical scale in discrete intervals. Varèse had a test tape he played to us with demonstrations of what can be done with a single original sound—a piano chord, a pursed-lip squeak, etc. When the variable-pitch “tuning” is combined with elaborate artificial prolongation of sound, you may derive a whole “organ” of tonal patterns, dozens and hundreds of them, from a single original; and each one will stand in a certain audible and basic relation to all the others.

I looked at the “score” of the taped parts and could recognize at least that, at any given second of time-lapse, there was a known and named tape-idea being “played,” in one track or in the other or in both. I'm not at all clear as to how the fantastic mixture was assembled, but I know that Ann McMillan and Varèse worked for months and months at some aspects of the assembly process; I heard tell that as many as nine recorders were required at some points to effect the mixing. It appears, too, that some of the tape was assembled in Paris in Varèse's absence—according to instructions. Just what those detailed instructions were I cannot possibly imagine, but evidently the “wrong notes” were not too many!

I also watched Varèse “conduct” the tapes as they played and there was no doubt at all that the whole thing was organized and memorized in his mind, “note” for “note.” He knew every plop, bang, sizzle.

I got to know a few too, before I was done. It's catchy stuff. Just for the fun of it I tried memorizing some of the cues for the changeovers between tape and orchestra, counting poops, tings, booms, thuds up to the precise instant of the cue. I actually got some of them right, as I listened to the performance.

The Set-Up.

Before it's too late, a word about the unique set-up of loudspeakers and orchestra. Loudspeakers to right and to left, of enormous power—and just how were they to be positioned, so that the people in the back seats would be properly "overwhelmed," yet those in the front rows, a few feet away, would emerge from the concert alive and unharmed? An intriguing problem.

How, also, was "natural" or "realistic" reproduction in a large hall to be achieved in this extraordinarily special case where the sound of loudspeakers had to compete direct, A-B, with the "natural" sound of living musicians?

When I arrived upon the scene there were two batteries of speakers in place all right, but no sound. Somebody had forgotten the speaker cables. Somebody also found that the Ampex gave forth with 600 ohms into McIntosh's hi-impedance inputs, and an SOS had been sent out, to fly in a pair of transformers. Before a sound was produced at all, I had moved in on those speakers, quick like a flash, and hauled them bodily to a new position. I found both sets aimed squarely at the front rows of audience, all of five feet away. Somebody had thought up an idea: lift the speakers up over their heads. And so a carpenter was at work building a kind of crating on which one speaker had already been mounted. It brought the tweeters of the giant Altec theatre speaker system about three feet above eye level—and the front row was already as good as dead, I figured.

We got the thing down on the floor again and the oldest Canby trick of all was called into play. Reflection. Sound source dispersion, for naturalness and realistic reproduction.

We just turned the speakers around and aimed them back into the uninhabited front corners of the big hall. There was a balcony above and stairs in each corner, but all surfaces were hard and good reflectors—no soundproofing in *this* armory. On one side the Altec theatre system now exposed its unlovely rear, complete with assorted paste-on instruction sheets. On the other was a smaller Altec system in a utility box plus a large woofer-only box, draped with a big hunk of old canvas to hide their equally unlovely rear parts. This was no visual feast for the eyes.

But, when Varèse got his tape started with all 100 watts blasting, the results were marvelous!

That is, the sound of each channel seemed to issue from a vast area in one corner of the big armory. The antiphonal opposition was perfect but the speakers were no longer noticeable except to the eye. And as for dispersion, the onlookers in the back of the hall, a couple of hundred feet away, were hit harder than those who were standing immediately behind the reversed speakers. Distribution—at colossal volume levels—was nearly perfect. And a maximum of naturalness (meaning a minimum of apparent distortion, a minimum of "loudspeaker" effect) was achieved by the corner reflection.

There was one further wrinkle. What about the balconies on each side? Well, to tell the truth, nobody in that hall could possibly miss one bit of the sound at such volume. But, to add more perspective, we

placed an additional speaker in each balcony, facing away from the audience into the upper corner. The result was excellent, but as I soon analyzed it, not for the reasons we had thought.

The upstairs speakers did add definition for the balcony audience, but more than this they added a wider perspective, a bigger spread of sound-source, to the speakers on the main floor. The result was a noticeably increased all-over naturalness, a better tolerance by the assembled ears for the terrific volume.

One of the still-unexplained acoustic phenomena was the fact that the left battery of speakers seemed consistently more natural in sound than the right batch, which had more of a "loudspeaker" sound throughout. (We traded channels on them, to be sure. It wasn't the tape.) Could have been phasing (which we didn't have time to

check), matching trouble, or even the quality of the different speakers themselves—the big Altec and a medium-sized Jim Lansing system. (The other side had the smaller Altec, plus separate Altec woofer and, upstairs, the new miniature AR-1 Acoustic Research system.) It would have taken weeks of testing to find out exactly what was happening—but the difference in tone quality was actually rather useful, as Varèse pointed out; it emphasized the separation of the two sound tracks, increased the sense of difference between them. Good. How often we can turn an engineering liability into an artistic asset!

Hiss, Grain

Perhaps I've said enough to whet at least a few aural appetites for a hearing of this work. Let me end with a look at the tech-

McIntosh



C-8P
\$99.50

without cabinet
with cabinet \$107.50

Professional AUDIO COMPENSATOR AND PRE-AMPLIFIER

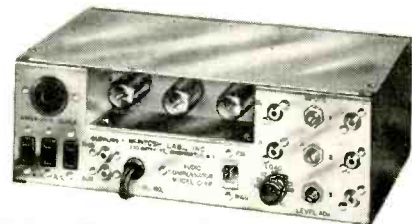
Now self-powered, the McIntosh C-8P is easily connected to any system to provide the most advanced in high fidelity compensation control. Abundant flexibility is possible with five bass (turnover) and five treble (roll-off) switches; an aural compensator; a rumble filter; separate wide-range bass and treble controls; and a five-program-source selector for tuner, tape recorder, microphone, and two phonograph cartridges. The McIntosh assures greatest listening pleasure from any sound source.

Small separate power supply (not shown) brings maximum convenience of installation. Rear panel (shown below) features five inputs, three outputs, equalization switch for magnetic or amplitude cartridges, variable load resistor for magnetic cartridges.

Write for Details and FREE
Record Compensation Guide

McINTOSH
LABORATORY, Inc.

324 WATER ST., BINGHAMTON, N. Y.
Export Division: 25 Warren St., New York 7, N. Y. Cable: Simontrice, N. Y.



Your Higher, More Rigid Specifications Demanded **ALL NEW**



GRAMPIAN "selected"

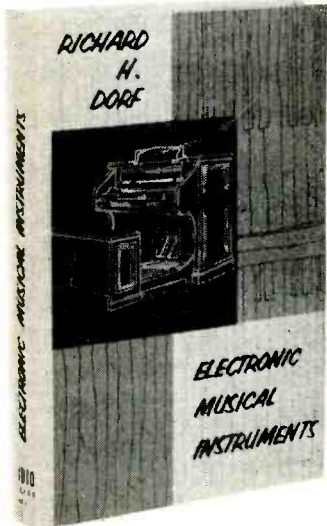
Famous feedback disc recording cutterhead delivers wide frequency range... 30 cps to 20 kc... silicone damped... top transient response flux correcting feedback... precision balanced armature... extremely stable!

use in conjunction with... REEVES-GOTHAM amplifier... capable of delivering 150 watts with less than .7% harmonic and intermodulation distortion from 40 cps to 15,000 cps. Includes all equalization for all of today's standard recording curves... at all speeds.

... for better sound recording, motion picture and TV everywhere

RE Reeves Equipment Corp.

10 EAST 52ND STREET, NEW YORK, NEW YORK



Keep informed—read

ELECTRONIC MUSICAL INSTRUMENTS

By

Richard H. Dorf

In one big volume, you can now learn all about the intricacies of commercial electronic organs, including the Allen, Baldwin, Consonata, Hammond, Minshall-Estey, Lowrey Organo, and others, together with many smaller instruments. Constructional details on the author's Electronorgan and the simpler Thyratone show you how to build one of these fascinating instruments for yourself. A compilation in book form of the author's articles in **Radio Electronics**, brought up to date and with many additions. Price \$7.50 (Foreign, \$8.00).

Customary discounts to dealers and distributors

RADIO MAGAZINES, INC., Book Division

P. O. Box 629, Mineola, N. Y.

Please send me copies of Dorf's ELECTRONIC MUSICAL INSTRUMENTS. I enclose check money order for \$7.50 each (Foreign, \$8.00).

Name

Address

City Zone State

nical quality of the tapes themselves, in this acid test alongside an actual orchestra. In spite of an assemblage of top equipment all along the line, there were severe problems that were not too well solved.

Worst of all was the tape hiss, highly audible at the enormous volume levels Varèse required in the reproduction, and made unpleasantly noticeable by the fact that the hiss was turned on and off as the piece changed from live sound to taped sound. We got rid of hum very nicely, after some extra grounds had been inserted here and there and various unbalanced potentials removed by tie-ups and line-cord reversings. But the hiss remained.

Two major causes operated to produce extra hiss, aside from the high level of reproduction. (1) The tapes had necessarily been copied and copied in the processing. This will *always* be the case in all forms of taped-sound composition in the future. (2) The final tape was double-track, copied from the two separate full-track "final" tapes. This materially added to the basic hiss, as was inevitable.

But Varèse himself unintentionally made the most trouble of all. When I arrived he was rehearsing Ann McMillan in a series of hair-raising volume changes on the Ampex controls, for extra tonal "umph." He wasn't satisfied with the tapes as they were, volume-wise. He got the "umph" all right, but with every change in volume, on each track, the change in hiss-level was positively alarming. It came *ahead* of the music, too, distracting attention at the wrong moments; it added immeasurably to the unpleasant sense of "electronic" sound, as opposed to the velvety silence in the live music background. The distraction, of course, was just as great when the hiss suddenly faded out (while one track was "resting" for a few moments) as when it suddenly faded up.

This was, indeed, distressing. And it took me two days to persuade Varèse that the way to minimize hiss is to *leave it unchanged*, let it sink into the subconscious background! Better the wrong volumes in the recorded sound itself than this dreadful rising and falling of hiss.

I also noticed a less important lack, not nearly as unpleasant as the hiss. There were in these final tapes no highs, I gradually realized, above about 5000 cps or so. The slap of the whip, the ping of a xylophone, appeared both live and in the recording; the difference in sound was very decided, though ideally there should have been no difference at all. Somewhere in the multiple copying somebody had slipped up, some circuit was awry.

Perhaps it was just as well, for another very clear problem was that of deterioration after many copyings. I'm sorry to say that, in direct competition with the live sound, the taped Varèse was to my ear noticeably coarse and grainy. Again, it's impossible to know just where in the assembly process the trouble may have occurred, or whether it was just plain cumulative and inevitable. Nobody else much noticed it and, if it hadn't been for the orchestra itself, playing right there in front of us, the graininess would have been negligible. But, as I say, this was an acid test, and acid tests are always interesting.

Technical conclusion? I think "Deserts," as a very serious and notable landmark in the probable development of taped "music," has pointed out some real problems in processing and reproduction that will be of importance to many engineers even though they may have no interest whatsoever in Varèse's artistic ideas. This is merely the beginning of direct-composed music on tape. We have a lot more to come in the future,

be it good or bad, and tape technology will surely have to meet the technical challenges.

A recording of "Deserts," for all to hear? Let us hope so, but don't expect to get much out of it. "Deserts" has two special appeals that simply cannot be put into recorded form. First—antiphonal sound, three-way. Might do it via a multiple-head tape player and a three-track tape. Not otherwise.

And second—"Deserts" makes its most unique impact via the contrast between living performers and taped sound. That, you can understand, can never be transferred to records, ever. And here, of course, is "Deserts" main point. Live performers "overwhelmed" by the sounds of machinery, organized a la Varèse! I wouldn't have missed it for anything.

STEREOPHONICS

(from page 17)

ence take exception, to the extent that a corner horn, designed for corner operation and not merely "adaptable" to the corner, will set up the same pressure field in its quadrant of operation as would an ideal 360-deg. radiator in a corresponding quadrant. Thus one could substitute for a corner speaker system and its bounding walls an ideal radiator at the point of wall intersection, without the walls, with the same field pattern. To simplify this concept, consider a radiator in Fig. 4 (A). Bisect this as in (B) with a rigid wall, and the unused half becomes a "mirror image" as in (C); a second bisection as in (D) gives a corner radiator with the same field pattern and wavefront geometry in its quadrant as did the original full-field radiator in the corresponding quadrant.⁶

Practice bears out the theory. Every-time the stage has been confined by adding artificial corners, the results have been less satisfying than where natural corners were used. For extremely wide spreads, however, one finds a tendency to notice the speakers instead of the sound. Experiences with three channels and with a third (center) channel produced by mixing the two outer channels would doubtless be interesting. Probably the full sized auditorium with theater equipment will be able to afford the three-channel array.

Concerned mainly with sound reproduction for the home, the two-channel system is outstanding whereas the three-channel system would be marginal over the 2-channel. For the largest living room, and for any auditorium up at least to little theater size, the 2-channel with natural corner placement has given highly satisfactory results.

The corner, whether for single-channel or stereophonic use, deserves vastly greater recognition than it has received. "If there is ever a culminating design for a loudspeaker it should be a corner type, for this affords the maximum performance for a given bulk of space requirement."⁷ The same paper from which this is quoted contains the essence and history of the art. The closing paragraph

⁶ This is a difficult concept; don't feel bad if you don't see it the first time through. The simplicity of the figure belies the complexity of the idea.

Build it Yourself!



Schober

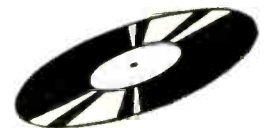
ELECTRONIC ORGAN KIT

Think of it! A full-sized concert organ that you build yourself for less than half the cost of a comparable instrument if you bought it factory built. Two 61-note manuals and a standard 32-note pedal keyboard make it possible for you to play the music you have always wanted in your home, and the nineteen stops and six couplers give you complete flexibility of tone. The Schober Electronic Organ is an instrument you will enjoy building—one that you will be proud to own and play.

EASY TO BUILD — EASY TO PLAY — EASY TO PAY FOR

Construction is not complicated nor particularly difficult, even though there are many parts to put together. Instructions are clear and complete, the console comes already assembled and finished, and with all mounting holes already predrilled. The woodwork is finished, and the bench and pedal clavier are ready to use. But best of all, you pay as you build—as little as \$22.50 gets you started. As you finish one section, you can order another, and spread out the cost as long as you wish.

HEAR IT IN YOUR OWN HOME—Send only \$2.00 (refundable when you purchase your first kit section) for a 10-inch LP demonstration record which shows you just what your own instrument will sound like when you complete it. One side, played by a professional organist, shows the fine tone of the organ. The other side contains twelve bands of tones, each note of the scale, which you will use for tuning the organ, or for tuning any other musical instrument.



THE Schober ORGAN CORPORATION

NEW HYDE PARK, NEW YORK

Export Dept. TELESCO, 270 Park Ave.

New York 17, New York

THE SCHOBOR ORGAN CORPORATION, Dept. 17
35 Dail Street, New Hyde Park, New York

Gentlemen:

Please send me your free booklet describing the new Schober Electronic Organ completely. I understand that this places me under no obligation whatever, and that the booklet is to be sent to me at no cost.

Enclosed is \$2.00. Please send me the Demonstration Record. Also include the credit certificate good for this amount on my first purchase of any Schober Organ Kit sections.

NAME (Please print)

ADDRESS

CITY ZONE STATE

states, "The principle of the corner speaker is so fundamental—the time should soon arrive that architects will be designing for corner speakers instead of showing house plans with wall speaker installations which were an obsolete fad in the mid 1930's." The recent experiments and public demonstrations with corner speakers in 2-channel stereophony remove any doubt as to the applicability of corner speakers to this art. There is some doubt that a full bass range can be achieved in a non-corner design because of size limitations; the vast increase in

woofer size precludes its function above perhaps 125 cps and a midrange horn to reach this frequency would itself be as big as current corner woofers. So the corner design appears actually to be the only feasible one for either single or multiple channel. The fact that it has been demonstrated successfully in all applications corroborates it as technically correct. There remains only to develop its acceptance in application to the extent the grand piano has been accepted.

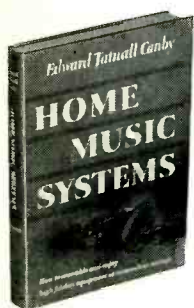
Practice

The formulas used by some stereophonic recordists dictating relations between room size, source size, microphone

spacing, and distance appear to be more applicable by violation than adherence. Each case is a law unto itself. Of course longitudinal and chronolateral stereo recordings are always special cases. Considering only the conventional or lateral stereo case, some tentative rules (not laws!) are suggested:

1. For large orchestra, or choir, almost but not quite bracket the group laterally, and keep the mikes high so as to reduce the distance difference from microphone to front and rear members.
2. For a small group, spacing wider than for bracketing may be resorted to for adequate separation. A 4-piece jazz combo occupied 12 feet and the mikes were nearly 15 feet apart.
3. Even the smallest condenser microphones are somewhat directional above 5000 cps; try to point the directional-maximum lobe at the spot occupied by soloists.
4. Expect to make mistakes, thereby building experience. Where an at-concert recording is to be made, try to rehearse and monitor the tapes as soon as possible; if rehearsal is impossible a rabbit's foot is suggested.

⁷ Paul W. Klipsch, "Loudspeaker developments," *Trans. Professional Group on Audio*, IRE, May-June 1953, p. 16.



NOW REVISED AND UP-TO-DATE:
The book that shows you
how to enjoy high fidelity
at great savings . . .

HOME MUSIC SYSTEMS

CHAPTERS LIKE THESE TELL YOU ALL

- **HIGH FIDELITY**
A complete explanation of what it means
- **WHERE TO GET IT**
The Radio Mail-Order House; Mail Consultation; The Local "Audio" Store or "Sound Salon"; The Custom High Fidelity Builder
- **AMPLIFIER AND CONTROLS**
- **THE SPEAKER AND ITS ENCLOSURE**
- **HOUSING THE SYSTEM**
Shelves and Tables; Rules To Stick To; Ready-Made Furniture
- **EXPANDING THE HOME SYSTEM**
Radio and TV; Tape; Refinements for the Perfectionist
- **CHOOSING A SYSTEM**
Specific Data on Systems, from \$60 up
- **IF IT BREAKS DOWN**

PLUS detailed appendices on mail order firms with available catalogues; locations of radio and Hi-Fi supply houses; Custom builders; selected books and publications; specified data on load resistances for magnetic cartridges.

HOW TO BUILD AND ENJOY THEM

By **EDWARD TATNALL CANBY**. This popular guide to high fidelity, long the standard work in the "hi-fi" field, has now been completely revised to include the big developments of the past two years. Still the *only* book to cover the building and maintenance of inexpensive home music systems, it shows you how you can enjoy finer musical reproduction, as well as better radio and TV reception, at a total cost of less than \$200.00!

EASY-TO-FOLLOW, SIMPLE DIRECTIONS AND DIAGRAMS

In this amazingly clear book, Mr. Canby, record columnist for *Harper's* and *Audio Engineering*, explains how a radio phonograph works; tells where to buy the individual parts, how much they cost, and how to house them for superior sound reproduction. He tells you how to test tubes, repair connections, and quickly locate the sources of breakdowns. He also appraises in detail the ready-made phonographs advertised by manufacturers as "high fidelity."

By far the most complete book on the subject ever published, HOME MUSIC SYSTEMS gives you everything you need to know about building "hi-fi" music systems for greater enjoyment of your records and radio music, at a low cost that will surprise you. *With 12 pages of photographs and diagrams.*

RADIO MAZAZINES, INC., Book Division
P. O. Box 629, Mineola, N. Y.

Please send me copies of HOME MUSIC SYSTEMS

I enclose check money order for \$3.95 each

Name
Address
City Zone State

OTL SYSTEM

(from page 15)

one or two electrostatic tweeters, as shown in Fig. 4 (B) and (C). Three of these tweeters are presently available: the Philco shown in Fig. 2; the "Kilosphere," made by Columbia Records; and the Kingdom-Lorenz SKL 100. The SKL 100 and the Korting are described in the literature.^{7,8} The author used a Western Electric 640A condenser microphone as a tweeter during the initial development of this amplifier-speaker system. This use of the 640A has also been described in the literature.⁹ The high frequencies from the 640A, while very clean, were too sharply beamed; the Philco unit, constructed as a section of a cylinder, diffuses the highs very nicely, especially when used in pairs with one unit on each side of the woofer.

Electrostatic speakers, as such, are not new. The Kyle electrostatic speaker was used with Peerless radio receivers about 25 years ago, and gave cleaner reproduction than the dynamic speakers of that day. The Kyle speaker required a polarizing voltage of about 1,000 volts, however, and insulation ruptures were common.

Basically, the electrostatic speaker consists of a rigid back plate, a very thin dielectric, and a foil membrane which forms the active or vibrating sound radiator. If an alternating voltage is applied across the back plate and the membrane, the electrostatic forces cause the membrane to be attracted to the back

⁷ Marvin Hobbs, "Electrostatic speaker accents high frequencies," *Electronics*, Nov. 1954, pp. 143-145.

⁸ Data Sheet on Kingdom/Lorenz Electrostatic Loudspeaker, Model SKL 100.

⁹ I. Rudnick and M. N. Stein, "Reciprocity free-field calibration of microphones to 100 kc in air," *Jour. A.S.A.*, Nov. 1948, p. 824.

plate twice in every cycle; this attraction results in a vibration of the membrane which produces a sound having twice the frequency of the applied alternating (signal) voltage.

If a d.c. polarizing voltage is applied between the back plate and the foil, the signal voltage merely is added to or subtracted from the steady polarizing voltage, and hence the frequency of the radiated sound is the same as the frequency of the signal.

In order to prevent tearing of the foil, its movement must be restricted, and this means that the electrostatic speaker should be fed only signals above 4 to 5 kc. The R-C coupling networks shown in Fig. 4 provide a high-pass filter, so that the tweeter is worked at normal listening levels only above 7500 cps. The exact component values shown in Fig. 4 are for the Philco units used with a special woofer; the experimenter will certainly want to vary these values for different makes of speakers, different types of enclosures, and different room acoustics. The capacitance of the Philco unit is .0024 μ f. The approximate composite and overall response curves are shown in Fig. 5.

A polarizing potential of around 250 volts is suitable for both the Philco and the Korting, and the connections shown in Fig. 4 will provide this value. The voltage may be increased to 450 volts or so for the Philco and Korting (but not the Kingdom-Lorenz), and in this

case terminal B in Fig. 4 should be connected to terminal D rather than B in Fig. 3.

The circuit symbol for an electrostatic tweeter is as shown in Fig. 4; the outline of a crescent indicates the rigid back plate, and the arc to the right of it indicates the foil radiating surface.

The author believes that for the best results in the natural reproduction of sound, the amplifier and speaker system must be considered as an integrated unit. The performance of the output stage is intimately related to its load,¹⁰ the phase shifts in the speaker or speakers are very important in determining the behavior of an over-all inverse feedback loop.¹¹ Much work is still to be done before we really know how to measure the transient response of an audio system.¹²

The author hopes that this article will add to the interest in direct-coupled amplifier-speaker systems, and that those who build this amplifier will be stimulated to make improvements in it and report their improvements in the literature.

¹⁰ A. W. Stanley, "The output stage; effect of matching on frequency response," *Wireless World*, Aug. 1946, pp. 256-259.

¹¹ Charles A. Ewaskio and Osman K. Mawardi, "Electroacoustic phase shift in loudspeakers," *Jour. A.S.A.*, July 1950, p. 444.

¹² Carl Olof Olsson and Kazimierz Orlik-Ruckemann, "The Dampometer," *Electronic Engineering*, Oct. 1954, pp. 420-428.

Notes on the Preamp with Presence and the Z729

Over 450 inquiries as to the sources for the chassis parts, the encapsulated choke, and the printed circuit panel resulted from the Miniaturized Preamp with Presence article in the May issue. So many, in fact, that we had to resort to a form letter to answer them although in many instances we answered questions not covered by the letter. For the information of any others who may be interested, the kits are now available from Harvey Radio Company, Inc., 103 W. 43rd St., New York 36, N. Y., Leonard Radio, Inc., 69 Cortlandt St., New York 7, N. Y., and Radio Shack Corporation, 167 Washington St., Boston 8, Mass.

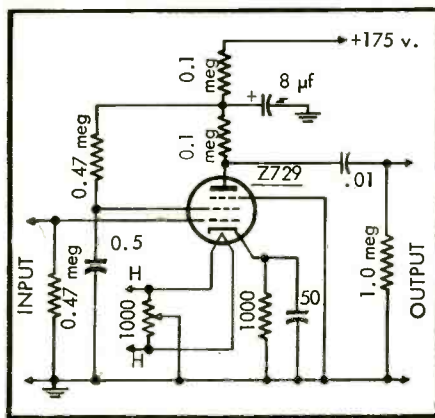
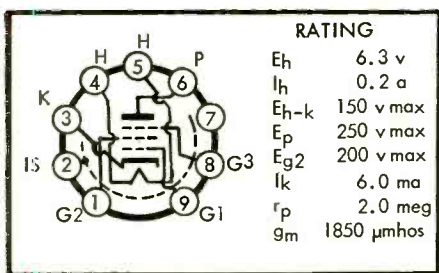
Many of the inquiries centered about the Genalex Z729 tube which serves as the phono preamp stage. This tube is a high-

gain pentode with very low noise and microphonics, and is particularly well suited for this application. Two were used in the original Preamp with Presence (*AUDIO*, Jan. 1954, but no reprints are available), but the circuit used in the miniaturized version requires only one.

Figure 1 shows the base connections of the tube, while Fig. 2 shows a typical circuit arrangement. With these values of plate load, a voltage gain of 110 can be realized. Changing the plate load resistor to 0.22 meg, the screen dropping resistor to 1.0 meg, and the cathode resistor to 2200 ohms will provide a voltage gain of approximately 180. The tube was used with the higher values of plate and screen resistors in the MPWP.

Fig. 1 (below). Base connections for the Z729 high-gain low-noise pentode used in the miniaturized preamp.

Fig. 2 (right). Typical circuit arrangement giving a voltage gain of 110 per stage.



"TRULY PROFESSIONAL!"

SAY
AUDIO
ENGINEERS...



Model 70
STUDIO
CONSOLE

AND
ARMCHAIR
ENGINEERS!



Model PBT
for HI-FI

... there's a
COMPONENTS

Professional

TURNTABLE

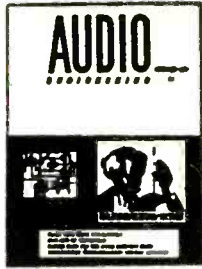
for BOTH!

... and only the "Professional" claims and proves truly professional performance, exceeding the best figures in record manufacture and FM transmission. Rumble -70db or better, wow and flutter 0.05% or less, speed accuracy, at least 0.25%. No other turntable approaches this performance... yet both the studio and home models of the Components "Professional" are providing it year in and year out for thousands of critical users. Why should you settle for anything less? User's net, Model PBT, \$99.50 (skirt optional at extra cost)... Model 70, \$295 f.o.b.

WRITE FOR FREE LITERATURE.

COMPONENTS
CORPORATION
DENVER NEW JERSEY

**SAVE
25%**



This is our

GROUP SUBSCRIPTION PLAN

Now you, your friends and co-workers can save \$1.00 on each subscription to **AUDIO**. If you send 6 or more subscriptions for the U.S., Possessions and Canada, they will cost each subscriber \$3.00 each, ¼ less than the regular one year subscription price. **Present subscriptions may be renewed or extended as part of a group. Remittance to accompany orders.**

AUDIO is still the only publication devoted entirely to

- Audio
- Broadcasting equipment
- Acoustics
- Home music systems
- Recording
- PA systems
- Record Reviews

(Please print)

Name

Address

New Renewal

Name

Address

New Renewal

Name

Address

New Renewal

Name

Address

New Renewal

Name

Address

New Renewal

Name

Address

New Renewal

U. S., Possessions, and Canada only

RADIO MAGAZINES, INC.

P. O. Box 629, Mineola, N. Y.

ABOUT MUSIC

HAROLD LAWRENCE*

DURING INTERMISSION at a recent Carnegie Hall concert, a critic regaled us with the following anecdote: A Parisian family had invited a country cousin about to be drafted to visit with them for a few days. They wine and dined him and took him to a performance of *Carmen* at the Paris Opera. During the entire first act, the cousin behaved in a rather strange manner, ignoring the activity on stage and staring intently at the brass in the pit. As soon as the curtain fell he leaped to his feet and, with a hastily murmured "Pardon," rushed down the aisle. A trombone player was just getting up when he saw the young man beckoning to him. He went over. The young man then asked the musician if he would not mind letting him examine his instrument. Why? Well, he just wanted to be of some help. Before you could say, "Georges Bizet," the trombone was snatched from the player's hands; and, with a screech of metal, it was wrenched in two. Beaming, the young man handed the pieces back to their bewildered owner with a flourish and a "Voilà!"

In case you are as puzzled as the poor trombonist, a word of explanation. The musically uninitiated cousin from the provinces imagined that the player was vainly struggling (particularly during the Overture) to disengage the slide from the bell joint. It's a good story, especially when accompanied by effective pantomime.

Actually our highly improbable young Frenchman is not so far removed from more experienced music lovers apparently under the spell of Euterpe. Have you ever scrutinized concert audiences, wondering what was going on behind many of the rapt expressions? In *Howards End*, the English novelist E. M. Forster penetrates the inner thoughts of members of a middle-class German-English family attending a performance of the Beethoven Fifth at the Queen's Hall. There's "Helen, who can see heroes and shipwrecks in the music's flood . . . Tibby, who is profoundly versed in counterpoint, and holds the full score open on his knee . . . their cousin, Fräulein Mosebach, who remembers all the time that Beethoven is 'echt Deutsch' and Fräulein Mosebach's young man, who can remember nothing but Fräulein Mosebach. . . ."

" . . . the Andante had begun . . . Helen heard the tune through once, and then her attention wandered, and she gazed at the audience, or the organ, or the architecture. Much did she censure the attenuated Cupids who encircle the ceiling of the Queen's Hall, inclining to each other with vapid gesture, and clad in sallow pantaloons, on which the October sunlight struck. 'How awful to marry a man like those Cupids,' thought Helen."

With the exception of the *Pastoral*, none of Beethoven's symphonies can be described as program music; and yet more fantasies seem to have been evoked by these abstract works than by many other blatantly suggestive pieces. Beethoven's Seventh, for example, provided the inspiration for a little essay published in Boston (1941) by Guy

Albert d'Amato. Entitled *Beethoven Beethovenized*, the writer set down his "phrase by phrase" impressions of the work. To Mr. d'Amato, the Symphony represents a complete life-cycle beginning with pre-natal stirrings and ending with the dance of death. Here are a few excerpts: The first movement opens with a "giant life-thrust, an explosive groan . . . Again the jolt. Those must be the first falls in an attempt to walk . . . Then begins the merry pace of childhood . . . Hopping impatiently, the body and spirit wait to be off. Soon, the mounting spirit in the strings and the increasing tingle of blood in the reeds end in a bursting joyous hail to the sky . . . The excitement suddenly flags in the bass . . . Something must be done with this strange weakness of the flesh: it is the child's worst enemy . . ." Had enough?

In a class with d'Amato's literary excursion is Philip Hale's review (1893) of the Brahms First. This is what went on in the critic's mind during the performance: "The musicians are in a forest. The forest is dark . . . The players wander. They grope as though they were eyesless. Alarmed, they call to each other; frightened, they shout together . . . Suddenly the players are in a clearing. They see close to them a canal. The water of the canal is green, and diseased purple and yellow plants grow on the banks of the canal . . . A swan with filthy plumage and twisted neck bobs up and down in the green waters of the canal. And then a boat is dragged towards the players. The boat is crowded with queerly dressed men and women and children, who sing a tune that sounds something like the hymn in Beethoven's Ninth Symphony . . . Darkness seizes the scene."

By way of contrast, here is Robert Benchley's reaction to a piece of symphonic music. This impression of Weber's *Euryanthe* Overture may be found in *Chips Off The Old Benchley* (Harper & Brothers, 1949): ". . . Boy, is that kettle-drummer having a good time? . . . Beat their hides off! At-a-boy! The brasses! Dear old brasses! Say, they certainly know how to blow, those boys. Hot dickety! It must be fun to have a horn, and, once you are sure of your note, to give it the works like that. You'd have to be pretty sure of your note, though, because if you put your eyeballs and temples and neck-chords into blowing it and it turned out to be the wrong note, you would sound pretty silly . . . Wait a minute! It sounds like the coda they are going into. The same note twenty-five times usually means they are nearing the end." It's too bad Benchley never became a part-time music critic.

Two Hokinson-type ladies listening to a Bruckner symphony at Carnegie Hall a couple of years ago were overheard exchanging the following remarks: "You know, I just have the feeling that these modern (sic) composers are trying to pull the wool over our eyes." To which the other replied: "Oh, I agree with you, only I feel that way about *all* composers."

Of course there are some people who, for one reason or another, find the concert hall an ideal place to snooze.

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

ADAPTING A RECORD CHANGER

(from page 21)

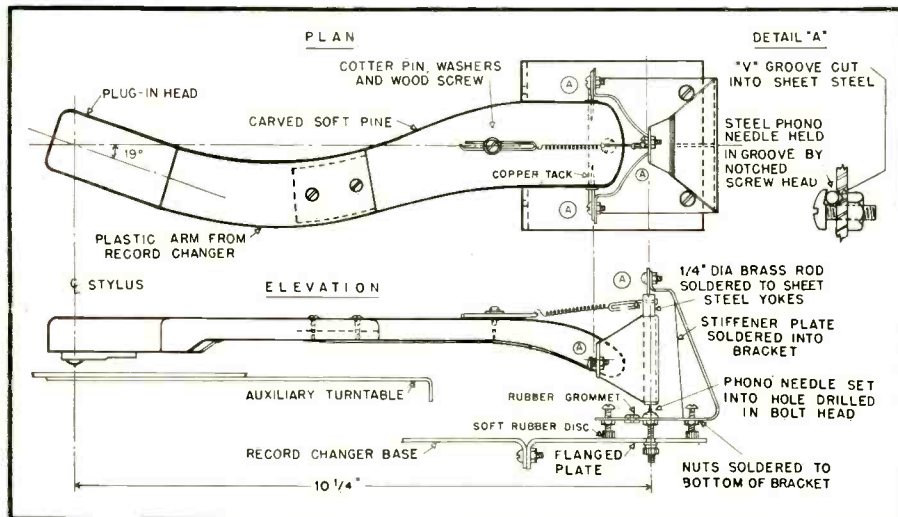


Fig. 4. Detail drawings show how the arm is made and pivoted.

swing consist of steel phonograph needles of the one-play type fitting into holes punched by a similar needle, preferably one having less taper. This punching operation required much care as the needles are very brittle and tend to break off in the hole. For this reason, soft metal was chosen for the bearing seats; a brass volume control shaft soldered to the steel yoke provides bearing seats for the horizontal swing, while copper tacks driven into the wood arm provide bearing seats for the vertical swing. Three of the bearing needles fit into V grooves cut with a file, and each is held in place by the head of a machine bolt. The fourth bearing needle was set into a hole drilled in the head of the long bolt which also holds the hinge assembly and the three adjusting screws down against the mounting bracket. Figure 5 shows the result.

Mounting the cartridge and making electrical connections was simplified by using part of a plastic replacement changer arm having a plug-in head. The

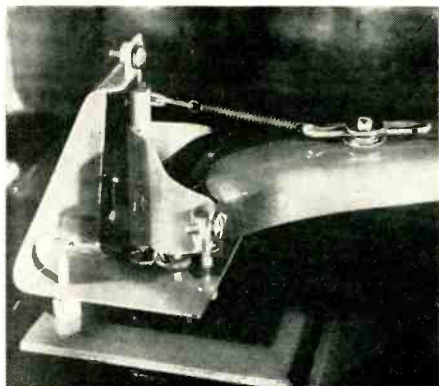


Fig. 5. Photo shows details of the pivoting and the counterbalancing spring.

end $3\frac{3}{4}$ in. of this arm was spliced to a soft pine extension which had been carved to a suitable length and shape. The end of this wood extension was carved to fit inside the plastic arm for the cement and wood screw splice. Figure 7 shows arm mounting dimensions.

The use of a spring-type counter-balance (Figs. 4 and 7) was dictated by lack of space for a longer arm with overhang. Stylus pressure is readily adjusted by means of the spring tension which is varied by the sliding cotter pin and locking screw arrangement. A suitable spring was selected by trial from an assortment of radio dial assembly springs.

The lead-in wires are stranded, plastic-covered antenna wire, the most flexible which could be found. For added flexibility, a short length of the wire is coiled at the base of the arm and is wedged in the rubber grommet where it passes through the hinge assembly. These wires are spliced to a shielded phono lead-in cable just under the mounting bracket.

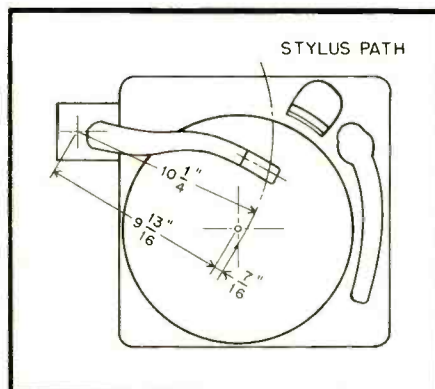


Fig. 7. These dimensions show how to mount the arm for minimum tracking error.

AR-1

WHEN you listen to the AR-1 at your sound dealers' (a good time is soon after you have attended a live concert), we invite you to make comparisons with large folded horns or bass reflex systems, but we suggest that you make no allowances for cabinet size.

The AR-1 is an acoustic suspension speaker system; it requires a small, sealed cabinet. The revolutionary engineering principle employed results in:

1. Full, clean, uniform reproduction to below 30 cycles. So far as we know the bass distortion levels of the AR-1 are lower than any that have previously appeared in published speaker data.

2. Determination of optimum cabinet size — for the AR-1, 25" x 14" x 11 $\frac{3}{8}$ ".

The small enclosure is a fortunate by-product, not the purpose of the acoustic suspension design, and is associated with an advance in rather than a compromise with quality. This fact is being recognized in technical press comment. For example, cabinet size was not even mentioned when Mr. Ben Drisko stated in his *Boston Post* audio column:

"The AR-1 definitely establishes a new high in direct radiator woof performance."

Or the *Audio League Report* of Pleasantville, N. Y., in describing the AR-1, wrote:

"... a speaker system represented as comparable to any system regardless of price or size ... To our audible judgment the system appears to live up to its claimed performance."

The AR speaker is available as a two-way system (12-inch acoustic suspension woofer and 8-inch cone tweeter in a sealed cabinet), or the cabled woofer may be purchased separately. Prices are from 132.00 to 185.00.

You may write for our free brochure, which includes frequency response and distortion level curves, to:

ACOUSTIC RESEARCH, Inc.
23 Mt. Auburn St.
Cambridge 38, Mass.

*Pat. applied for by E. M. Villchur

New Standard of
Professional Recording

Dynacord

PROFESSIONAL TAPE RECORDER
by PENTRON

- 3-Motor Drive
- Dynamic Braking
- Automatic Cycling

Model DTM
Tape Mechanism \$395 net
Model DS-10
Professional Preamplifier \$90 net

Conforms throughout to NARTB standards. For portable use, rack mounting or custom installation. See . . . hear . . . other new Pentron hi-fi and portable models . . . the only complete line in the industry.

THE PENTRON CORP. Dept. 185
777 S. Tripp Ave., Chicago 24, Ill.

Canada:
PENTRON Atlas Radio Corp., Ltd., Toronto

HI-FI SALES EXECUTIVES WANTED!

(Earn up to \$20,000 per Year)

The West's largest and fastest-growing High-Fidelity distributor has openings for two new men. Individuals of exceptional background and ability are required, and those who qualify will be recompensed accordingly.

Our usual procedure is a three to six month trial period on generous salary, followed by a long-term profit-sharing contract. This should yield at least \$8,000 to \$10,000 the first year, \$10,000 to \$12,000 the second year, and \$12,000 to \$15,000 the third year, with \$18,000 to \$20,000 as the eventual goal.

Those are actually conservative figures. If the growth of our business continues at the present rate, an income of \$15,000 the second year is perfectly possible.

Of course we are seeking men far above average. Our minimum requirement is two years of college, an I.Q. of 140, a thorough cultural and educational background, and an interest in high-fidelity, with some knowledge of the subject.

In addition you must have one or more of the following qualifications: Administrative experience, sales ability, advertising experience, or advanced technical knowledge. Note that we prefer intelligent men of broad educational background, rather than mere technicians or salesmen. Young men preferred—age limits 20 to 35. Naturally, we want men who enjoy meeting the public and talking to audiophiles.

Our set-up, as you can judge from the foregoing, consists of specialists in various fields, each of whom is trained to conduct hi-fi demonstrations, and who divide their time equally between the sound showroom and their desks.

If qualified, communicate immediately by letter, giving full details.

HI-FIDELITY HOUSE
536 S. Fair Oaks, Pasadena 1, Calif.

NEW PRODUCTS

(from page 34)

• **Newcomb FM-AM Tuners.** Two new tuners recently introduced by Newcomb Audio Products Company, Inc., 6842 Lexington Ave., Hollywood 38, Calif. are designed as companion pieces to the Newcomb "Compact" series of hi-fi amplifiers. Both are housed in decorator-designed satin-gold-finish cabinets. The "Compact 100" tuner is a self-powered two-knob model designed for use with any high-fidelity amplifier equipped with volume and tone controls. It features a multiplex output jack to permit adaption for reception of binaural broadcasts. FM response is ± 1 db from 20 to 20,000 cps with sensitivity of 5 microvolts for 30-db quieting. The deluxe "Compact 200" model affords 2-microvolt sensitivity for 30-db quieting, a new FM detector system with triple limiting action which affords reduced distortion, improved adjacent channel rejection, and exceptionally effective limiting on weak signals. Response is 20 to 20,000 cps within ± 0.5 db and distortion is less than 0.2 per cent at 5 volts output. Both models incorporate "snap-in" AFC, edge-lighted dials and flywheel tuning. The "200" also incorporates a visual tuning indicator which is operative on both FM and AM. **L-8**

• **High-Fidelity Three-Speed Tape Recorder.** Many professional features are included in the new Tapesonic Model 70-B tape recorder manufactured by Premier Electronics Laboratories, 382 Lafayette St., New York 3, N. Y. Three separate heads permit monitoring from tape while recording. A front-panel A-B switch is provided for comparison between original and recorded program. A dual-track unit equipped with panel-mounted $4\frac{1}{2}$ -in. VU meter, the Tapesonic is push-button operated. Control circuitry includes seven electrically-interlocked relays and one solenoid. Drive mechanism uses three dynamically-balanced motors. Flutter and wow are 0.1 per cent at 15 ips, 0.2 per cent at 7.5 ips, and 0.3 per cent at 3.75 ips. Mixing channels are provided for microphone, radio and phono inputs. **L-9**

• **Low-Frequency Filter.** Developed essentially for low-frequency applications ranging from 15 to 10,000 cps, the new Allison Model 2-A Filter Set fulfills the need for a continuously-variable high-pass and low-pass audio-frequency filter for both laboratory and production usage. The equipment has only two controls for each group of filters. One control is a switch in octave steps, while the other is a multiplier. The filter is a passive network which will handle 5 watts in a 600-ohm circuit. Loss in the pass band is approximately 1 db, making unnecessary any amplification to compensate for insertion loss. Calibrated vernier control allows the use of bands either wider or narrower than an octave. The 2-A exceeds the requirements of the ASA for instruments of this type. Complete technical data and performance curves are available from Allison Laboratories, 14185 Skyline Drive, Puente, Calif. **L-10**

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.

• **Audio Engineer:** 8 yrs. experience in design and product development. Have had complete responsibility in development of amplifiers, preamps, and AM-FM tuners. Presently employed as Chief Engineer for leading hi-fi mfr. Desire responsible position with aggressive organization in components or instrumentation field seeking new product ideas. Box 701, Audio.

CLASSIFIED

Rates: 10¢ per word per insertion for noncommercial advertisements; 25¢ per word for commercial advertisements. Rates are net, and no discounts will be allowed. Copy must be accompanied by remittance in full, and must reach the New York office by the first of the month preceding the date of issue.

THE AUDIO EXCHANGE has the largest selection of new and fully guaranteed used equipment. Catalog of used equipment on request. Audio Exchange, Dept. AE, 159-19 Hillside Ave., Jamaica 32, N. Y. OL 8-0445.

AUDIO EXCHANGE EXCHANGES AUDIO

25-50% DISCOUNT. Factory-fresh guaranteed LP records. 69¢ and up; send 20¢ for catalogue. SOUTHWEST RECORD SALES, Dept. A, 4710 Caroline, Houston 4, Texas.

HIGH-FIDELITY SPEAKERS REPAIRED. Amprite Speaker Service, 70 Vesey St., New York 7, N. Y.

AMPLIFIERS — HI-FI

45% off 40,000-cycle amplifiers, recorders, pianos, organs, accordions, typewriters, movie equipment, binoculars. Amazing bargains! ABELMART, 466 Belmont, Paterson 2, N. J.

ENJOY THE FINEST — Magnecorder M-90 portable recorder like new, 30% off. Patton, 1259 Third Avenue S.E., Cedar Rapids, Iowa.

SALES — SWAP — SERVICE on all types of new and used audio equipment. ARGUS SERVICE COMPANY, 235 Lyons Avenue, Newark, N. J. WAverly 3-3025

6-Element Broad Band FM antenna, All seamless aluminum. \$10.95 ppd. Wholesale Supply Co., Lunenburg 10, Mass.

BINAURAL OUTFIT: 20-20 Concertone STW-4, matched Shure cardioids, tape, cable, \$600. Getting drafted. Stereocraft, Box 172, Lincoln, Nebr.

FOR SALE: ALTEC 820A speaker system, \$385; excellent condition. I have 12 reels 2-400' type 111A Scotch Magnetic Tape all on 10-in. aluminum reels. Used very little. Cost \$11.50 each. Make offer. C. H. Goddard, Fitzwilliam, N. H.

TURNTABLE, Professional: up to 16-in. records; any speed 20 to 90 rpm, with fine long arm with easy interchange of cartridges. Nice condition: very scarce; \$135 express prepaid in U.S.A. Adolph Hoefler, 8330 Kingsbury Blvd., Clayton 24, Mo.

HI-FI SYSTEM: Craftsmen C-800 tuner, \$75; Webster changer with LP diamond GE cartridge; Maestro 90-watt amplifier with Peerless output transformer, \$140; Altec 604-C speaker in corner horn, \$220. Will sell entire system for \$400. Ford, Apt. 9F, 360 First Ave., New York 10, N. Y. OR 4-3136.

REK-O-KUT B-16H turntable, \$185; UTC 4C filter, \$85; Also Daven pads and UTC LS-series transformers. M. E. Boyd, 903 Salmon Drive, Dallas 8, Texas.

CONCERTONE Network Recorder, \$495. Write for details. Thomas, 800 S. Pugh, State College, Pa.

FOR SALE: Wharfedale Super 12/CSAL, \$60. P. J. Sidney, 114 W. 64th St., New York 23, N. Y. SUsquehanna 7-4449.

CONCERTONE 1501 Recorder, dual heads, carrying case, monitor, amplifier and speaker, hardly used, perfectly new condition, original carton. Cost \$430.00, sacrifice \$285.00. MINIFON Pocket Wire Recorder in case, microphone, earphones, perfect condition. Cost over \$300.00, disposing \$185.00. Box CL-1, Tele: Sacramento 2-2021 (New York City).

Enthusiastic collector desires correatape-spondence with others with similar interests. Belden, New Brunswick, N. J.

VARTYPING Composition, DSJ, IBM, paste-up, ruled forms, advertising layout and technical matter in English and foreign languages. Catherine Rein, 874 Broadway, at 18th St., New York 3, N. Y. GRamercy 7-5720.

WANTED: Cutters, RCA MI-4887 recording heads, upright type, any condition. Also Altec 21-C, prefer 150-A base, and Edison cylinder records. George Somes, 1247 Savoy St., San Diego 7, Calif.

PROFESSIONAL DIRECTORY

"Continuously Since 1944"

HOLLYWOOD ELECTRONICS
DISTRIBUTORS OF HI-FI COMPONENTS
EXCLUSIVELY

7460 Melrose Ave. Los Angeles 46, Calif. WEbster 3-8208

HIGH-FIDELITY HOUSE

Most complete stock of Audio
components in the West

Phone: RYan 1-8171

536 S. Fair Oaks, Pasadena 1, Calif.

"EVERYTHING IN HIGH FIDELITY"

From Primary Components
to Completed Custom Audio Equipment

KIERULFF

Sound Corp.

820 West Olympic Blvd. • Los Angeles 15, Calif.
Richmond 7-0271 ZEnith 0271

CANADA

High Fidelity Equipment
Complete Lines • Complete Service
Hi-Fi Records — Components
and Accessories

**ELECTRO-VOICE
SOUND SYSTEMS**

141 DUNDAS ST. WEST. TORONTO, CANADA.



Miracle

MTI-M PRESTO SPLICER

now available for magnetic
1/4" Hylar & Acetate Tapes

- A heat weld
- No Cement
- No adhesives
- . . . in seconds!

- Diagonal cut capable of withstanding 3 pound pull
- Inaudible with playback amplifier gain at maximum
- Also splices leader to any base magnetic tape without adhesives.

Literature and sample splice on request!

PRESTOSEAL MFG. CORP.

3727 33rd st., Long Island City 1, N.Y.

Industry People ...

Sidney Herbstman has assumed presidency of G & H Wood Products Co., Inc., following purchase of all outstanding company interests; immediate plans include expansion of plant and production facilities to handle scheduled additions to the Cabinart line of hi-fi furniture. No administrative or personnel changes are intended . . . Jay H. Quinn has resigned as manager of sales and advertising for Fairchild Recording Equipment Company—plans to establish a sales company in the New York City area catering to broadcast and TV stations and recording studios.

William T. Saxon has joined Ampex Corporation as employment supervisor—formerly held the same position with Chrysler Corporation's plant at San Leandro, Calif. . . . New management team at Kierulff Electronics, Inc., Los Angeles, Calif., is led by C. R. Nissen, vice-president, and C. T. (Cap) Kierulff, general manager. Other members are Dave Rodabaugh, sales manager; Homer Nielsen, sales supervisor; Harry Smith, stock control supervisor; Robert Byrnes, credit manager, and Barney Edgerton, office manager . . . Andrew H. Bergeson, who retired with the rank of Captain from active Navy duty in 1954 to join Stromberg-Carlson Company's Washington office, has been elected vice-president, engineering.

C. J. Tressler has been named sales manager of The Pentron Corporation, Chicago manufacturer of tape recorders; Irving Rossman, Pentron president, retains the title of Director of Sales . . . Appointment of Melvin L. Hayden as advertising-sales promotion manager of National Company, Inc. is announced by Lynn Eaton, vice-president in charge of sales. Prior to joining National, Hayden was radio-television director of the Ingalls-Minter Company, Boston advertising agency.

Jack L. Hobby has been promoted to manager of publicity and institutional advertising for Raytheon Manufacturing Company, Waltham, Mass.; he will report directly to Richard P. Axten, whose appointment as public relations director was announced last month . . . N. J. Jochem, with Gates Radio Company for the past twelve years, has been upped to the position of director of engineering . . . Ernest Heitsch, formerly sales promotion manager for Thor Corporation, Chicago, has joined the Andrew Corporation, also Chicago, in a similar capacity . . . W. Walter Jablon, electronics pioneer, has resigned from Radio City Products Company to join Presto Recording Corporation as sales manager.

Industry Notes ...

Allied Radio Corporation, Chicago, has opened a new store in Evanston, Ill., exclusively for the demonstration and sale of high-fidelity equipment. The new store covers an area of 2400 sq. ft., is modern in appearance, and includes carefully planned facilities for giving adequate display to the great variety of components and music systems that Allied distributes. At the same time the company has expanded the hi-fi studios in its main store in Chicago. All stores in the Chicago area are under the supervision of L. M. Burchett.

The Hack Swain Library of Musikon tape programs will henceforth be duplicated and distributed exclusively as a part of the Livingston Master Tape Library, according to a joint announcement by C. E. Smiley, president of Livingston Electronics Corporation, and Hack Swain, president of Carey-Swain, Inc. The arrangement with Livingston for the production and marketing of its present and future releases was made with the primary purpose of freeing Carey-Swain to expand facilities for recording, film editing, and TV film production.

Newark Electric Company, Chicago, has purchased Acorn Radio and Electronics, Inglewood, Calif., according to announcement by Sam Poncher, Newark president. It will be operated as a wholly owned subsidiary under the name of Newark Electric Company of California. Officers of the new company are Mr. Poncher, president, and Abe Poncher, vice-president and secretary. In charge of the California outlet will be Herbert R. Baker, widely known in Western electronic circles. The purchase was the third step in Newark's comprehensive expansion program, which also included acquisition of the six-story Newark Building in Chicago and construction of elaborate high-fidelity studios.

LEONARD RADIO PROUDLY PRESENTS ...

—LIVINGSTON—

"BI-FI"

FOR YOUR LISTENING
PLEASURE



FOR THE ADVANCED AUDIOPHILE, LIVINGSTON HAS DEVELOPED A SUPERBLY ENGINEERED, UNIQUELY DESIGNED, LOW COST BINAURAL PLAY-BACK UNIT. JUST LOOK AT THESE PLAYBACK FEATURES:

Flutter & Wow: Negligible
Hum Level: 60 db Down
Output: 5 millivolts
Frequency Response: ± 2 db 20-15,000 cps
At 7 1/2 ips
Selector Switch: Binaural; Monaural; Half Track (You can play standard half track, or binaural tapes)

Attractively housed in a blonde or mahogany finished cabinet as shown:

NET \$119.50

Chassis only: \$99.50

**Bi-Fi Recorded Tapes
from the Livingston Library
Net \$10.00 ea.**

Superbly recorded music by the leading domestic and foreign combos, orchestras and choral groups, adds a new dimension to your listening pleasure . . .

- # 701 Schubert—Unfinished Symphony
- BN Sibelius—Finlandia
- # 703 Mussorgsky—Night on Bald Mountain
- BN Borodin—Polovtsian Dances
- Sibelius—Valse Triste



- # 709 Music, Wine, and Candlelight—Vol. 1
- BN (by Austria's leading Schrammel group)
- #AT7 Rampart Street Ramblers
- 5BN (Wilber de Paris)

Complete listings of Staggered-Head and Stacked-Head Binaural, Dual, and Single track recordings on request. Write Dept. BN-1.

LEONARD RADIO, INC.

69 Cortlandt St., New York 7, N.Y. Cortlandt 7-0315

Mail and phone orders filled,
25% deposit, Balance C. O. D.

New! 160 page, 1956 Audio Reference Guide Available soon. . . . Enter your name on our mailing list now!

To the **WILLIAMSON**
Specification



in 4
stock
types
\$27.75
NET

PARTRIDGE WWFB Output Transformers

Built to the famous Williamson specification the Partridge WWFB covers full A.F. range with lowest distortion. Stock types comprise 0-95, 1-7, 3-6 and 7-5 ohm sections. Secondary windings are brought out to eight separate sections of equal impedance. Power Rating 16 watts continuous steady tone.

For specifications and prices of Partridge Transformers and name of local distributor write to:—

Partridge Transformers Ltd.
c/o British Electronic Sales Co. Inc.,
23-03, 45th Road, Long Island City, 1, N.Y.

ALSO AVAILABLE

Type UL 2. A p.p. Transformer of "C" Core design, specially designed for really high quality A.F. reproducing equipment. Power up to 50 watts \$26.30 Net.

TYPE C.F.B. Leads the way in "C" Core Technique. Power up to 60 watts from 22 cjs to 30 K cjs. Distortion less than 1% with no N.F.B. \$43.75 net.



PARTRIDGE
TRANSFORMERS LTD
TOLWORTH · SURREY · ENG.

LISTEN!

Spend just 10 minutes listening to the great Daystrom Crestwood tape recorder and learn for yourself the wonders of its exclusive "Living Sound."

Your dealer will be glad to give you this convincing test.

It's a real thrill!

DAYSTROM
Crestwood
TAPE RECORDERS
DAYSTROM ELECTRIC CORP.
POUGHKEEPSIE, N. Y.

ADVERTISING INDEX

Acoustic Research, Inc.	45
Allied Radio Corp.	31
Amplifier Corp. of America	48
Audak Co.	38
Audiogersh Corporation	32
Bell Telephone Laboratories	12
British Industries Corporation . facing p. 1, 3	
Classified Ads	46
Components Corporation	43
Daystrom Electric Corp.	48
Electro-Voice Inc. 1, Cover IV	
Electro-Voice Sound Systems	47
Fairchild Recording Equipment Corp. ...	7
Goodmans Industries, Ltd.	36
Harvey Radio Co., Inc.	35
Heath Co.	37
High Fidelity House	46, 47
Hollywood Electronics	47
Hughes Research and Development Laboratories	6
Hycor Co., Inc.	4
Jensen Manufacturing Company ...	Cover 2
Kierulff Sound Corporation	47
Lansing, James B., Sound Inc.	48
Leonard Radio, Inc.	47
McIntosh Laboratory, Inc.	39
Orradio Industries, Inc.	Cover 3
Partridge Transformers, Ltd.	48
Pentron Corp.	46
Pickering & Company, Inc.	11
Pilot Radio Corp.	33
Presto Recording Corporation	29
Professional Directory	47
Rauland-Borg Corporation	2
Reeves Equipment Corp.	40
Rek-O-Kut Company	9
Schober Organ Corporation	41
Technical Tape Corporation	5
Tung-Sol Electric, Inc.	8

New VU Magnemite*



Spring-Motor Battery-Operated Portable Tape Recorder

Now you can consistently make professional recordings under the most gruelling field conditions. Tapes will faultlessly play back on all professional and home recorders. Ruggedly designed for maximum dependability and top-notch efficiency. Combines unlimited versatility of performance with extreme simplicity of operation. Choice of fourteen models available for every conceivable application.

Incorporates a multi-purpose VU monitoring meter for precise setting of recording level without earphone monitoring. Meter also accurately indicates condition of "A" and "B" batteries. Five single speeds as well as two, three and 4-speed models available. Units weigh only 19 lbs. with batteries and measure 6½" x 9½" x 14¼". Higher speed models meet NARTB standards. All recorders are guaranteed for One Full Year.

Write for complete technical specifications and direct factory prices to Dept. AE

AMPLIFIER CORP. of AMERICA

398 Broadway, N. Y. 13, N. Y.

* U. S. Pat. Reg. M. T.

quality control of

JIM LANSING *signature*

speakers by

Bl testing

One of the final inspections given all Jim Lansing Signature Speakers is made with a Bl tester. This instrument gives a direct, accurate measurement of each unit's electrical quality.

Magnet size and flux density alone do not determine speaker efficiency. The force available to move the dynamic assembly in any speaker is proportional to:— the flux density surrounding the voice coil, the length of conductor uniformly



subjected to lines of force, the current flowing through the wire. This total relationship (Bl factor) can be measured by applying a voltage to the voice coil and measuring the force exerted by the dynamic assembly.

In the Signature Bl tester a speaker's ability to support a known weight is read directly on a calibrated watt meter. No other commercially produced speakers have a higher Bl factor than do Signature units with their edge-wound wire ribbon 4" voice coils. And, before being released, every Signature Speaker must meet the same high standards.

JAMES B. LANSING SOUND, INC.
manufacturers of precision transducers
2439 FLETCHER DR. LOS ANGELES 39, CALIFORNIA

SIMPLE AS



To make it just as easy as possible for AUDIO's readers to subscribe, order books, get further information about the new products and the new literature mentioned in the pages of the magazine, or to get catalog sheets and brochures describing articles advertised, we provide herewith three cards. We know that many readers are loath to cut coupons from the pages of their favorite magazine because they have told us so. And we know that many times one would like to have complete and thorough data about something he sees in these pages, yet he considers it too much trouble to hunt up paper and envelope—not to mention the stamp—and write a long letter detailing what he wants to know. This is just as simple as we know how to make it with the exception of stenciling each subscriber's name and address on each of the postcards—an operation which would be highly impractical from the printing standpoint. But from now on, when you want more information about something you have seen advertised or mentioned in AUDIO you need only indicate it on the appropriate card, print your name and address, and drop it in the nearest postbox. We pay the postage, and it goes without saying that we wouldn't include these cards if we didn't welcome your use of them. And, for the first time, you can enter your subscription without sending a penny with your order—we'll bill you later. For books, we'll have to ask for the money in advance, but only for books.



Readers have told us that they often want to know more about some of the items mentioned in the *New Products* and *New Literature* pages of the magazine, but that they do not want to take the time and effort to write to each one of the sources individually to get all the information they need. As a matter of fact, in an average issue there are usually ten items in the *New Literature* column, and between ten and fifteen on the *New Products* pages. It is conceivable that the average reader might want information on at least ten of these items, since they are selected with the interests of most of AUDIO's readers in mind. Thus one would have to have ten envelopes, ten sheets of paper, and ten three-cent stamps, together with the need for writing the ten letters and inscribing each with name and address. We do it all for you, assuming that you are willing to circle the items about which more information is desired and to write your name and address once. We will forward your inquiries to the organization involved, and you will receive the data you want with only one inquiry. Isn't that as simple as A B C?



In just the same way you can get more information about any product that is advertised in the pages of AUDIO. But there is a little more work involved in this, since you must indicate the item in which you are interested and the name of the manufacturer. However, you still have to write your name and address only once for all the information you want about advertised items from a single issue—unless you want to know all about everything. If your cards indicate that this is likely to be the case, we will make them larger to fit your requirements. In the meantime, if you do need more space, you might subscribe to two copies.

Audio, P. O. Box 629, Mineola, N. Y.

GENTLEMEN:
PLEASE ENTER MY SUBSCRIPTION TO **AUDIO**

FOR:

FOR OFFICE USE

CHECK <input type="checkbox"/>	MONEY ORDER <input type="checkbox"/>
BILL ME <input type="checkbox"/>	PAYMENT ENCLOSED <input type="checkbox"/>
LIFE - \$50 <input type="checkbox"/>	U.S.A. ONLY
2 YEARS - \$7 <input type="checkbox"/>	(FOREIGN - \$10)
1 YEAR - \$4 <input type="checkbox"/>	(FOREIGN - \$5)

NAME _____

ADDRESS _____

CITY _____

ZONE _____

STATE _____



BUSINESS REPLY ENVELOPE
First Class Permit No. 142, Mineola, N. Y.

AUDIO

P. O. Box 629
Mineola, N. Y.



BUSINESS REPLY ENVELOPE
First Class Permit No. 142, Mineola, N. Y.

AUDIO

P. O. Box 629
Mineola, N. Y.

BOOK ORDER

Please send me the books checked below, postage paid. I enclose check money order for \$ _____ in full payment.

- the 2nd audio anthology
Board cover, \$3.00
 - the 2nd audio anthology
Paper cover, \$2.00
 - Electronic Musical Instruments
Dorf. \$7.50 (Foreign \$8.00)
 - Wear and Care of Records and Styli,
Weiler. \$1.00
 - _____
 - _____
- NAME _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____



BUSINESS REPLY ENVELOPE
First Class Permit No. 142, Mineola, N. Y.

AUDIO

P. O. Box 629
Mineola, N. Y.



To start receiving **Audio** monthly without any effort on your part to locate one on the newsstands or at your jobber's, mark the appropriate boxes with crosses, tear out the card, and drop it into a handy postbox. If you are one of those who always pays in advance, we will accept your check or money order—we do not recommend cash to be sent through the mails—enclose the card in an envelope, and mail. This will cost you an extra three cents, so if you wait until we send you a bill, we'll enclose a business reply envelope for your convenience. We try to make it as easy for you as we know how.

Unfortunately, we do have to have money with your order in the case of books, for many of those our readers order are those which we must purchase from other sources. And even with our own publications, we do have to pay the printer if we expect to have him print the next book we put out. But we can help in this fashion—if you want any book from any publisher, just list the name of the book and the author and we'll get it for you. It helps if you know the name of the publisher, but that isn't necessary. If you aren't sure about the price, make a good guess and enclose that amount—we'll mail the book COD for the difference, or we will refund the overpayment if you are too generous. In any case, we pay the postage on the book, although you will have to pay the postage on the envelope you use to send us the order card. Try it once and see how easy it is!

AUDIO, P. O. Box 629, Mineola, N. Y.

Please send me further information on the items circled as listed in New Products and New Literature

- L 1
- L 2
- L 3
- L 4
- L 5
- L 6
- L 7
- L 8
- L 9
- L 10
- L 11
- L 12
- L 13
- L 14
- L 15
- L 16
- L 17
- L 18

NAME _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

AUDIO— Please send me complete information

about— _____ advertised by— _____

NAME _____
ADDRESS _____

At the end of each item of **New Literature** or **New Products** you will notice a letter and a number—the letter indicates the month and the number indicates which item it is. All you have to do to get full information about the product or to get the literature described is to circle the appropriate number, add your name and address—printed if possible, so the information doesn't end up in the Post Office at Washington—and mail it to us. We'll do the rest, and you may be sure that we'll be prompt because we are just as anxious for your inquiries to get to their destination as you are—and besides, we don't have room enough around the office to accumulate a lot of cards. Circle one item, if you wish, or all of them—we'll carry on from there. This whole system breaks down if there is a charge for the **New Literature** described, so if you can suggest any improvements in this service, we would appreciate hearing about them.

We can't think of any way to simplify this card without actually listing every product mentioned throughout the magazine, and this becomes an impossibility—we don't always get the ads sufficiently far in advance of printing time to make it possible to plan such an elaborate card. So if you want to know more about any product advertised—except from the Classified section—just write down the product and the name of the advertiser as well as your own name and address. We can't promise that no salesman will call, but we think it highly unlikely, because very few manufacturers have enough salesmen to answer all the inquiries individually in person. But we are sure that each manufacturer will be glad to send you the information you want without any obligation. If we find that this card doesn't have enough room for all the information you want, we will have to enlarge it, but let's try this one for size.