Music lovers everywhere know that Columbia LP records mean more listening pleasure—not in playing time alone, but in superb quality of reproduction. Yet few listeners outside the professional circle realize the degree of perfection which this record quality requires in every step of manufacture and processing. Take the original sound recordings and the processing masters, for example. Frequency response, signal-to-noise ratio, distortion and surface noise must measure up to standards which would have seemed entirely impractical a few years ago. But Columbia has found that Audiotape and Audiodiscs are an ideal combination for meeting all of these exacting requirements—Audiotape for recording the original sound and Audiodiscs for the masters from which stampers are made. In fact this same record-making combination is now being used with outstanding success by America's leading producers of fine phonograph records and broadcast transcriptions.

You can get this same sound perfection in your recording work, too—with Audiodiscs and Audiotape. Their superior quality is the result of more than 12 years of specialized experience by the only company in America devoted solely to the manufacture of fine sound recording media, both tape and discs.


AUDIO DEVICES, Inc.
444 MADISON AVE., NEW YORK 22, N. Y.
Export Dept.: 13 East 40th St., New York 16, N. Y., Cables "ARLAB"
CONTENTS

Audio Patents—Richard H. Dorf ........................................ 2
Letters ................................................................. 6
Book Reviews .......................................................... 8
Audiana ................................................................. 10
Editor’s Report .......................................................... 12
Azimuth Film Calibration—Michael Rettinger ...................... 15
A Twin-Channel Utility Amplifier—R. S. Houston ................. 17
Design and Construction of Horn-Type Loudspeakers—Wayne B. Dowdy .................................................. 18

AUDIO engineering society SECTION

The Problems of Low-frequency Reproduction—Saul J. White .................. 20
Employment Register .................................................... 56
New “The Super Tweeter”—Ralph P. Glover and Karl Kramer ........ 22
Audio in the Home—William C. Shraeder ................................ 24
The I.R.E. Review—1952—Harrie K. Richardson ....................... 26
Use Your Present Tuner—Ulric J. Childs ............................ 29
Equipment Report—Altec A-333-A ..................................... 32
Audio Techniques ........................................................ 34
Broadcast Short-Cuts ...................................................... 34
Record Review—Edward Tatnell Casby ................................. 36
New Products ..................................................................... 42
Errata .............................................................................. 49
New Literature ............................................................... 51
Price and Product Changes—Radio’s Master Reports ............... 57
Industry People ............................................................. 59
Advertising Index ........................................................... 60

COVER

Build your own furniture to suit—as one owner has done. This attractive unit (the furniture, that is) was assembled from aluminum tubing and small clamps, using simple wooden slats for the top and for shelves. The record changer is covered by a plastic half-globe, molded to order, and speaker, amplifier, and control unit are all included in this installation. Design by Dean McClure, architect; equipment by The Electronic Workshop. Details of the construction will appear in next month’s issue.

RADIO MAGAZINES, INC., 342 MADISON AVE., NEW YORK 17, N. Y.

AUDIO ENGINEERING (filing registered D. B. Pd. Off.) is published monthly at 342 Madison Ave., Lancaster, Pa., by Audio Engineering, Inc., D. B. Pd. President. Henry A. Rechard, Secretary-Treasurer. Executive and Editorial Offices: 342 Madison Avenue, New York 17, N. Y. Subscription rates—United States, U. S. Possessions and Canada, $2.00 for 1 year; $5.00 for 2 years; elsewhere, $4.00 per year. Single copies 25c. Printed in U. S. A. All rights reserved. Entire contents copyrighted 1952 by Radio magazines, Inc. Entered as second-class matter February 9, 1950, at the Post Office, Lancaster, Pa., under the Act of March 3, 1919.

AUDIO ENGINEERING • APRIL, 1952
your ear will tell you

the performance of the TRIAD Hi-Fi Amplifier is equal to that of amplifiers costing much more

Listening tests conducted before groups of critical music lovers have proved that the difference in reproduction qualities between the low cost Triad Amplifier and the other higher priced units is undistinguishable. Available in kit form only, with complete assembly instructions, the Triad HF-10 Amplifier provides valuable experience while affording substantial savings. In quality and performance it is a fitting companion to the finest sound system components available today.

**prices**

HF-10 Kit — includes S-31A, R-14A, A-741 and C-10X Triad transformers, chassis, prints and assembly instructions. ......................... $43.00

HF-10A Kit — same as above except for substitution of HS-81 output transformer for S-31A. $63.50

Both of above available with 500/250/125 ohm output

Write for Catalog TR-52

![audio patents](image)

**RICHARD H. DORF**

One-control circuits exist by the hundreds, but here is one of especial interest because it is so simple. It combines in a single control attenuation of either high or low frequencies, together with a very definite flat-response position which is not dependent on balancing out opposing tone control circuits. The inventor is Robert J. Cowles of Fort Wayne, Indiana, and the patent, No. 2,571,112, is assigned to Farnsworth.

The circuit of the tone control appears in Fig. 1. It consists of a potentiometer of 1 megohm, with a tap 200,000 ohms above the “ground” end, and two capacitors, one being .02 µf, and the other .002 µf. The first vacuum-tube stage is a voltage-amplifier triode and the second the familiar cathode-coupled phase inverter with outputs taken from the plate and the cathode. The stages are direct-coupled; the correct bias for the second stage can be had by the right combination of R1 (for a satisfactory low plate voltage to be transferred to the following stage) and R2 for a high cathode bias to offset most of the positive grid voltage. R8 would normally have a fairly high value in any case in this kind of phase inverter, and should be the same as R2. The potentiometer has no effect on the bias of the second stage since it is not carrying d.c.

With the potentiometer arm at the tap point the circuit appears as at (A) in Fig. 2, since the 800,000-ohm portion of the potentiometer and its shunt capacitor are shorted out. The .02-µf capacitor has very little effect on frequency response.

With the potentiometer arm at the top, the circuit is as shown at (B) and is easily recognized as a high-boost circuit. At intermediate positions, the amount of action is regulated by the value of resistance across the .002-µf capacitor.

At (C) in Fig. 2 is shown what happens when the potentiometer arm is moved below the tap, for instance to the point where there remains 100,000 ohms between the arm and the .02-µf capacitor. The .002-µf capacitor, the 800,000-ohm resistor (portion of the potentiometer), and that part of the potentiometer between the arm and the tap (assumed at the moment to be 100,000 ohms) no longer have any effect since no audio current flows through them and they can cause no voltage drops. The circuit is reduced to a series resistor and capacitor between plate of the first stage and ground, with the first-stage plate connected to the second-stage grid. The effective resistance in the circuit is now made lower as the potentiometer arm is moved downward, raising the frequency at which the resistance and the reactance of the capacitor become equal. Above this frequency...

[Continued on page 4]
PLUS PERFORMANCE

in QUALITY
SOUNDCRAFT MAGNETIC RECORDING TAPE

New Reeves Soundcraft Recording Tape outperforms all others. Experience will show you that Soundcraft Tape has unique lasting qualities, over and above other magnetic recording tape.

Soundcraft Tape is the only tape manufactured by specialists with 20 years of continuous experience in the sound recording field... a tape perfected after years of painstaking research and experimentation to produce the ultimate in fidelity.

REEVES SOUNDCRAFT TAPE-CHEST*

The merchandiser you've been waiting for: five reels of Soundcraft Tape (5 or 7 inch) packed in the sensational 5-drawer Tape-Chest at no extra cost! Constructed of durable, lined boxboard, the handsome pyroxylin-coated Tape-Chest is a permanent filing cabinet. Stores each reel horizontally in an individual drawer to protect it and lengthen its life.

Soundcraft Tape is easy to sell, because it's so superior. The Tape-Chest will make it easy to sell reels five at a time!

REEVES SOUNDCRAFT TAPE
HAS ALL THESE PLUS PERFORMANCE FEATURES!

Send for FREE Descriptive Literature—Now

Reeves Soundcraft Corp.,
10 East 52nd Street, N. Y. 22, N. Y.

Gentlemen: Please send me, without cost or obligation, your Soundcraft Magnetic Tape brochure showing how I can get better recording results.

NAME ________________________________

ADDRESS __________________________________

CITY ______________________ STATE ______

1. Pre-coated for greater adhesion.
2. Constant speed coating process for output uniformity.
3. Each foot checked to guarantee absolute output uniformity.
4. Buffed for improved high frequency response.
5. Surface lubricated to insure quiet performance.
6. Six-spoke reels to prevent sagging when stored.

REEVES SOUNDCRAFT
10 East 52nd Street, N. Y. 22, N. Y.

THE ONLY RECORDING MATERIALS PERFECTED AND MANUFACTURED BY RECORDING SPECIALISTS

Please write Reeves Soundcraft for additional information.

www.americanradiohistory.com
LITERATURE describing this new portable equipment will be rushed to you as soon as we receive your request. AUDIO & VIDEO also sells and services the fine products of the leading audio equipment manufacturers. We will be glad to supply you with descriptive literature, prices and delivery information.

CHECK those manufacturers whose products you would like details about. Use this advertisement as a convenient coupon.

Exclusive in Canada ........ In Washington, D. C. ........
Canadian General Electric Co., Ltd. Gallant Engineering Company
212 King Street, West 261 Constitution Avenue
Toronto, Canada Washington 1, D. C.

AMPEX STANDARD RECORDERS ....
AMPEX SPECIAL RECORDERS ....
Altec ................................ M. M. & M. Tape ....
Cinema ................................ Pre-Recorded Tape 
Editall ................................ Recording Rates
Electro-Voice ...................... Telefax ....
Fairchild Disc .................
Longevin .........................
Lansing ......................

AMPHETAX SERIES 400-A MAGNETIC TAPE RECORDER

SOLD AND SERVICED BY

Audio & Video PRODUCTS CORPORATION
730 Fifth Avenue • New York 19, N. Y.
Plaza 7-3091

Please send me literature and details concerning the products of those manufacturers whose names I have checked above.

Name
Title
Company Name
Mail Address

ANTI-NOISE BRIDGING AMPLIFIER

John W. Rieke of Astoria, N. Y., is the inventor of an interesting amplifier for bridging a balanced line and discriminating against noise picked up in the line along its run. The patent, No. 2,547,538, is assigned to Bell Telephone Laboratories.

As shown in Fig. 4, \( V_1 \) and \( V_2 \) are balanced amplifiers, both passing cathode currents through \( V_3 \). Audiometric measurements of the balanced line produces equal and opposite grid voltages on \( V_1 \) and \( V_2 \). The cathode currents are equal and opposite and there is, therefore, no a.c. component through \( V_3 \).

Noise voltages picked up by the line usually tend to be identical on both lines with respect to ground. The resulting noise currents in \( V_1 \) and \( V_2 \) are equal but in phase; they pass through \( V_3 \), the plate resistance of which produces substantial degeneration, greatly lowering the gain of the amplifier for noise inputs of this kind.

The plate load resistors for \( V_1 \) and \( V_2 \) are \( R_1 \) and \( R_2 \) respectively. Output for following stages or for an outgoing line from the bridge is taken from the plate of \( V_3 \), in the normal manner. The plate output of \( V_3 \) is fed to the grid of \( V_4 \), which greatly enhances the amplification of \( V_1 \) in the following manner:

If we assume an instantaneous positive voltage (from the input) at the grid of \( V_1 \) and a corresponding negative voltage at \( V_3 \), a resulting positive voltage appears at the plate of \( V_3 \) and the grid of \( V_4 \). This decreases the plate resistance of \( V_3 \) and since the cathode of \( V_3 \) is connected to the plate of \( V_3 \), the bias on \( V_3 \) is reduced. The net effect is to increase the amplification. Rieke claims an amplification by this method twice that obtainable without the special circuit.

\( R_5 \) and \( R_6 \) provide bias voltage for \( V_3 \), while \( R_7 \) and \( R_8 \) do the same for \( V_4 \). \( R_5 \) is a cathode-bias resistor for \( V_4 \); \( R_6 \) is the grid leak for \( V_3 \). \( R_7 \) causes degeneration in \( V_3 \) and is made variable for use as a gain control over a limited range.

\( V_1 \) and \( V_3 \) should have high grid-plate transconductance; pентоды are best, though tetrodes or triodes might work under certain circumstances. \( V_5 \) should have high a.c. impedance and moderate d.c. plate resistance. It is also ideally a pentode.
The BEST BUY in Recorders!

PROTECTS YOUR COMMERCIALS WITH PRECISION TIMING

- SAVES LABOR WITH REMOTE CONTROL
- SAVES MONEY BY STAYING ON THE JOB
- SAVES TAPE WITH 15,000 cps AT 7½ ips

AMPEX ELECTRIC CORPORATION
Redwood City, California

Advanced Series 400-A

Write for Bulletin A-211
If you've been looking for an audio output tube that's stable under the most severe conditions—completely dependable—then this is it! The Tung-Sol 5881 is rugged both mechanically and electrically—and directly interchangeable with the 6L6.

In creating the 5881, Tung-Sol engineers have made lavish use of the design and production techniques which have proved themselves over the past fifteen years—zirconium coating over the carbonized metal plate and pure barium getter to effectively absorb gas for the life of the tube—gold plated wire to minimize grid emission. These are but a few of the major design improvements in the 5881.

Tung-Sol produces the 5881 under laboratory conditions, to assure peak efficiency and maximum uniformity. You'll find this tube has the stuff to take the whole range of audio service requirements from protracted stand-by periods to repeated heavy overloads. So, if absolute reliability is essential in your audio circuits, the Tung-Sol 5881 is a "must." Order it from your regular supplier.

Write for characteristics and performance data

TUNG-SOL ELECTRIC INC., NEWARK 4, N. J.
Sales Offices: Atlanta • Chicago • Culver City (Calif.) Dallas • Denver • Detroit • Newark
Tung-Sol makes All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes.
TESTING OF GUIDED MISSILES like the famous "Matador" (above) involves a complicated job of telemetering. At the Air Force Missile Test Center in Florida, a series of down-range telemetry stations pick up pulsations transmitted by the missiles in flight. These signals are recorded on tape for later decoding.

"Scotch" Sound Recording Tape captures every impulse, reproduces it with unequalled fidelity. This gives engineers a dependable, lasting record of valuable engineering measurements—stress, strain, temperature, etc.

TECHNICAL ASSISTANCE on every phase of sound recording is yours for the asking from your local 3M Service Representative. Backed by the extensive facilities of the 3M Laboratories, he's ready to help with problems, show you new techniques, assist in selection of equipment. Call him today... or write us direct: Dept. AE-42, Minnesota Mining & Mfg. Co., St. Paul 6, Minnesota.

TAPE RECORDINGS of telemetered missile flights are gathered at a central point for study and analysis. By playing back the recordings, engineers can re-create each flight in its entirety.

Here's why those in the know demand CANNON PLUGS

- Long rubber bushing lines clamp and shell. Serves as cable relief, gives better insulation.
- Molded rubber sleeve for moisture seal. Protects cable entry.
- Flat top of steel shell assures correct polarization with finger touch action.
- New type thumb latch lock gives smooth action in or out.
- Both socket and pin contacts machined from solid brass, gold plated. Hand tinned solder cups.
- Rubber cushion at mating face improves moisture protection and insulation.
- Spring-loaded insert retainers provide easy insert removal.

The Cannon Electric UA Plug was designed to answer the R. M. A. request for the ideal audio plug. It is the ultimate in a quick disconnect for low level sound and related circuits. Incorporating a wealth of design and construction know-how resulting from Cannon's many years of pioneering in this field, the Type "UA" Series typifies the close attention to important detail that distinguishes every type of Cannon Plug—the world's most complete line. The UA Series is sold through selected franchise distributors. Engineering bulletins sent free on request.

CANNON ELECTRIC
CANNON ELECTRIC COMPANY, LOS ANGELES 31, CALIFORNIA
Factories in Los Angeles, Toronto, New Haven. Representatives in principal cities.
Address inquiries to Cannon Electric Company, Department B-109, P. O. Box 75, Lincoln Heights Station, Los Angeles 31, California.

Book Reviews


Written as the corner-stone of an up-to-date radio servicing library, this volume should find a welcome acceptance among many audio devotees, particularly the newcomers. Over one third of the 611 text pages appertain directly to audio subjects, from the generation of the transmitted signal through amplifiers, loudspeakers, pick-ups, record-players and recorders, both wire and tape.

The treatment is clear and easy to comprehend, and a 26-page glossary of technical terms leaves no mystery unanswered for the neophyte. Mr. Ghirardi has always written on the assumption that knowledge of the correct functioning of equipment was essential to proper servicing. To this the present book is no exception. One wishes he had devoted a bit more thorough treatment to some of the newer and more obscure details of circuitry. As an example—the bootstrap flyback circuit for high voltage generation in TV receivers is hardly mentioned, and the inter-carrier system, used in probably 90 per cent of all current commercially-built receivers is allowed less than a page. Conversely, the treatment of antenna, particularly UHF types, is outstanding.

Each chapter has its summary questions, with answers for alternate ones in the appendix. As a reference work for those needing refresher data, and as a source of information to those needing complete explanations, this book acquires itself well, and if the ensuing volumes serve as well in their respective fields the authors have rendered a real service to the technical industry should not forget.

—L.B.K.


Somewhat out of the ordinary for the average audio-minded reader is this volume which—while not offered as a thorough treatise on pianos—will nevertheless give the lay reader, and even the engineer, an entertaining evening's reading. Most of us are unaware of most of the history of the piano, and still more unfamiliar with its construction beyond what we can see when we raise the top or remove the front.

This reviewer was especially interested in the requirements of voicing a piano, and the effect of this work on the ultimate tone of the instrument. The author's presentation of charts and graphs serves to point out the differences he describes in various instruments—both individually and by type.

Mr. Briggs' style is far from pedantic, more often becomes thoroughly conversational. It is this characteristic, rather more than the subject matter, which makes the book so entertaining. The reader learns about pianos through Briggs' eyes, and from Briggs' own experience.

AUDIO ENGINEERING • APRIL, 1952
MOLYBDENUM PERMALLOY
POWDER CORES
(New technical data now available)

COMPLETE LINE OF CORES
TO MEET YOUR NEEDS

★ Furnished in four standard permeabilities — 125, 60, 26 and 14.

★ Available in a wide range of sizes to obtain nominal inductances as high as 281 mh/1000 turns.

★ These toroidal cores are given various types of enamel and varnish finishes, some of which permit winding with heavy Formex insulated wire without supplementary insulation over the core.

HIGH Q TOROIDS for use in Loading Coils, Filters, Broadband Carrier Systems and Networks—for frequencies up to 200 KC

For high Q in a small volume, characterized by low eddy current and hysteresis losses, ARNOLD Moly Permalloy Powder Toroidal Cores are commercially available to meet high standards of physical and electrical requirements. They provide constant permeability over a wide range of flux density. The 125 Mu cores are recommended for use up to 15 kc, 60 Mu at 10 to 50 kc, 26 Mu at 30 to 75 kc, and 14 Mu at 50 to 200 kc. Many of these cores may be furnished stabilized to provide constant permeability (±0.1%) over a specific temperature range.

★ Manufactured under license arrangements with Western Electric Company
Perfect Tracking

...with no tone arm resonance -
New Gray 108-B
Arm for all records has new suspension principle...

Perfect tracking of records and virtual elimination of tone arm resonances are only two advantages of this versatile, specially-designed arm—the finest yet developed. It satisfies every requirement of LP reproduction, permits instant changing from 78 r.p.m. to LP (micro-groove) or 45 r.p.m., and assures correct stylus pressure automatically. GE or Pickering magnetic pickup cartridges are interchangeable and slip into place quickly and easily. Maintains perfect contact with bad records, accommodates records up to 16" in diameter.

106-SP Transcription Arm - Assures fidelity of tone for every speed record.

Three cartridge slides furnished enable GE 1 mil, 2½ mil, or 3 mil, or Pickering cartridges to be slipped into position instantly, with no tools or solder.

Low vertical inertia, precisely adjustable stylus pressure.

Gray Equalizers - Used as standard professional equipment by leading broadcast stations, these specially-designed equalizers assure highest tonal quality... new record reproduction from old records... constant velocity frequency response for conventional or LP records. Uses GE or Pickering cartridges.

Please write for bulletins describing the above equipment.

Azimuth Film Calibration

Any electrical reproducing system needs test standards in order to check the performance from time to time in routine maintenance operations. For amplifiers and complete transmission systems, the test standard generally is provided by an oscillator covering the entire audio frequency spectrum; a gain set, which is a means of introducing a specific amount of loss; and an output meter, usually a VU meter. Electrically, the circuits are set up with feeding into the gain set, with a meter to measure the amount of signal fed in; then comes the amplifier or system under test; and finally, a loudspeaker network and the output meter. In use, the gain set is adjusted so that the output voltage is exactly equal to the voltage fed to the gain set. Then, obviously, the gain of the amplifier or system is equal to the loss introduced by the gain set. Since the gain set is accurately indicated in db, the loss—and consequently the gain of the amplifier—is indicated within tenths of a db.

Similarly, tests of disc reproducing systems are usually conducted by playing a calibrated frequency record through the system and measuring the output. With any measuring system of this sort, it is obviously necessary that the standard be made with as much accuracy as possible.

One of the characteristics of a magnetic tape reproducing or recording system is that the recorded striations of the magnetic material on the tape must be accurately adjusted so that they are exactly perpendicular to the tape motion. If a tape is recorded on one machine and played back on the same machine, it does not make much difference if the head gap—which locates the magnetic striations—is not so accurately aligned. But if the tape is to be recorded on one machine and played back on another, as is often the case, the two machines must be adjusted to a high degree of accuracy.

Adjustments of the head position or azimuth, as it is called, are made in practice by playing an alignment tape—usually of such a frequency that the wavelength of the signal on the tape is equivalent to the gap width—and adjusting the head position or azimuth to obtain a maximum output. The frequency employed is usually 15,000 cps for a 15 in./sec. machine, 7500 cps for a 7½ in./sec. machine, and so on. This works out to be exactly the same wavelength on the tape regardless of the speed, so that one alignment tape will serve to adjust any tape machine. The figure of 18,000 cps corresponds to a speed of 18 in./sec., which is standard for motion picture recording, where the speed of film travel is 90 ft. per minute, or 18 in./sec.

Since it is necessary to have a standard, it is obvious that such a standard must involve an adjustment of absolute perpendicularity, and standard alignment tapes must therefore be made to give an accurate measurement of this. The method of doing this requires an accurate measurement of the gap azimuth, an operation which is impossible to do by inspection. The unique head construction described by the author gives a simple and accurate check of the recorded tape with a minimum of effort.

Low-Frequency Reproduction

The design and construction of a loudspeaker which is completely satisfactory for the reproduction of low frequencies is fraught with a number of conflicting requirements. The market demands a high efficiency, low resonant frequency, low distortion, complete control of the frequency response of the apparatus, and a uniform sound output to very low frequencies. Any mechanically vibrating device, e.g., a loudspeaker cone, has a natural resonant frequency. Below this frequency, the sound output decreases rapidly, a natural acoustic phenomenon. Furthermore, for a low resonant frequency, a relatively high weight, or mass, is required. Yet when the mass is high, transient response suffers. It almost seems as though it would be impossible to build a good low-frequency speaker, yet the speaker art has progressed to the point where excellent units are available. Among the elements which must be balanced against one another are cone weight, cone stiffness, cone motion, sufficient stiffness to provide damping, and high efficiency—which means enough turns of wire on the voice coil.

Most of the characteristics of any mechanical system can be expressed mathematically, and from these equations, the direction the designer should look in perfecting a product can be determined with considerable accuracy. The author has given these equations, with some explanation of their importance. Since the movement of the voice coil depends almost entirely on the forces acting upon it, it is interesting to note what is involved in these forces—the flux density in the air gap, the length of wire in the voice coil, and the current in the coil. Thus it is seen that it is desirable to have a high magnetic flux density in the air gap, which pinpoints the importance of magnet size and strength. Similar points of importance are also noted from the equation for acoustic output, which shows the part the housing plays in obtaining good low-frequency responses.

The cone excursion, for a given acoustic output, depends upon the diameter of the cone, and upon the frequency. In the author's example, a 12-in. speaker can radiate one acoustic watt with a maximum cone excursion of 1/16 in., at a frequency of 200 cps—and such an excursion is well within the ability of the speaker without excessive distortion. But to radiate the same acoustic power at a frequency of 50 cps requires a cone excursion of one inch—which would undoubtedly wreck the speaker completely. As the size of the speaker is increased, the movement of the cone decreases for a given amount of power output.

Not the least important of the conditions which cause distortion is cabinet vibration. If any portion of the cabinet vibrates independently, the cabinet may radiate more sound than the speaker. Therefore, cabinets should be as massive and well braced as possible.
New 1952 Heathkits

Heathkit
5" OSCILLOSCOPE KIT
- New "spot shape" control for spot adjustment — to give really sharp focusing.
- A total of ten tubes including CR tube and five miniatures.
- Cascaded vertical amplifiers followed by phase splitter and balanced push-pull deflection amplifiers.
- Greatly reduced retrace time.
- Step attenuated — frequency compensated — cathode follower vertical input.
- Low impedance vertical gain control for minimum distortion.
- New mounting of phase splitter and deflection amplifier tubes near CR tube base.
- Greatly simplified wiring layout.
- Increased frequency response — useful to 5 MHz.
- Tremendous sensitivity 0.05 RMS per inch Vertical 6V RMS per inch Hor.
- Dual control in-vernier sweep frequency circuit — smoother action.
- Positive or negative peak internal synchronization.
- Multivibrator type Wide Range Sweep Generator.
A brand new 1952 Heathkit Oscilloscope Kit with a multitude of outstanding features and really excellent performance. A scope you'll truly like and certainly want to own.
The kit is complete with all parts including all tubes, power transformer, punched and formed chassis, etc. Detailed instruction manual makes assembly simple and clear — contains step-by-step instructions, pictorials, diagrams, schematic, circuit description and uses of scope. A truly outstanding value.

MODEL D-7
SHIPPING WT. 24 LBS.

$43.50

Heathkit VACUUM TUBE VOLT METER KIT
- New styling — formed case for beauty.
- New truly compact size - Cabinet 4½" deep x 4½/16" wide x 7½" high.
- Quality Simpson 200 microamp meter.
- New ohms battery holding clamp and spring clip — assurance of good electrical contact.
- Highest quality precision resistors in multiplier circuit.
- Calibrates on both AC and DC for maximum accuracy.
- Terrific coverage — Reads from 1½V to 1000V AC, 15V to 1000V DC, and 1 to over 1 billion ohms resistance.
- Large, clearly marked meter scales indicate ohms, AC Volts, DC Volts, and DB — has zero set mark for FM alignment.
- New styling presents attractive and professional appearance.

The 1952 Model Heathkit Vacuum Tube Voltmeter! Newly designed cabinet combines style and beauty with components. Greatly reduced size to occupy a minimum of space on your work-bench. Covers a tremendous range of measurements and is easy to use. Uses only quality components including 1% precision resistors in multiplier circuits for greatest accuracy. Simpson 200 microamp meter with easy to read scales for fast and sure readings.
All parts come right with kit, and complete instruction manual makes assembly a cinch.

MODEL V-5
SHIPPING WT. 5 LBS.

$24.50

You save by ordering direct from manufacturer.

The Heath Company
...Benton Harbor 25, Michigan

Audio Engineering • April, 1952
LET GEORGE DO IT!

Among the most universal of human failings is the tendency all of us have to "Let George Do It." But the time comes occasionally when this tendency is likely to be our undoing. Now is one of those times, it appears.

While the use of phonograph records as a source of high-quality music for home systems has unquestioned advantages, there are times when it is desired to let someone else change the records—partially because we are too lazy, perhaps, and partially because radio stations usually have more records than we have. In addition—and of even greater importance—the live programs obtainable from the better FM stations are capable of exceeding in range and in freedom from distortion even the best phonograph records.

There is no advantage for a high-quality home music system without good music to play on it, and when we run out of records—or tire of those we have—or for any number of other reasons, we can hear still more music from the radio. Most audiophiles (we have avoided this word since a friend of ours in Camden told us he could always recognize one because of the raspy in his system) depend on radio for a large percentage of their program material.

The principal reason for these comments is the condition into which FM seems to be falling. Only recently has one New York station fallen prey to listeners' apathy—with several hours per week less good music than we were accustomed to having. WFDJ—technically one of the best equipped stations in the city—shuttered during February.

The National Association of Radio and Television Broadcasters—at the 30th Annual Membership Meeting—is devoting one morning session to FM business, with a view to reactivating the interest in FM throughout the country as much as possible. A continuing campaign is in progress—city by city and area by area—to work in combination with set manufacturers so as to increase FM listening time and to increase FM receiver sales. The advantages of FM are known to most of us, but the vast majority of the public is seemingly unaware that there is much gained by listening on FM rather than AM.

How can we help, you ask? And at this point the meaning of the caption above becomes apparent. Most of us are guilty at one time or another of putting off writing a letter of commendation to a radio station for its good work. We justify this procrastination by saying that enough other people will write in so we just don't bother. We let George do it.

If we are to continue to have FM broadcasting, those of us who want it and use it had better stir our stumps somewhat and let the stations know we want them. If you listen to a certain station on FM for three hours a day regularly, let the station manager know about it. If you listen exclusively on FM and want more or better programming, write the station.

The two principal advantages of FM appeal to two different types of listeners. To most of A’s readers, the superior quality is of principal concern, and we are willing to spend relatively large sums of money to equip ourselves to hear music as well reproduced as we can possibly have it. To everyone who listens to a radio at all, the elimination of the effect of static is a very definite advantage, at least for part of the year.

If we all do our duty and tell the FM station management that we’re listening and that we’re behind them, perhaps we shall be spared the loss of even one more station from the airwaves. If we should happen to lose all of them, we would most certainly become a group of individual disc jockeys in a short time. Let’s all be George.

THE AUDIO FAIR IN CHICAGO

By now, most readers are aware of the Audio Fair to be held in Chicago on May 23 and 24, at the Conrad Hilton Hotel, immediately following the Annual Parts Show. We are looking forward to a large crowd—many who will come to see what an Audio Fair is like—and to meeting some of our readers in the Midwest area. A is always willing to give a boost to any enterprise which will help audio, and the New York Audio Fairs have proved that they help audio in a big way. The Audio Engineering Society is sponsoring the exhibit, as it does the Eastern shows, although there will not be any convention activities at this time. However, it is suggested than any Chicagoans who have a strong interest in audio might well make this the occasion for a local affair, and either A or the Society or both would most certainly be willing to cooperate.

ANOTHER ANTHOLOGY

Work has already begun on the Second Audio Anthology, which will take up where the first one left off, and continue up to the present. Publication date has been set tentatively for September 15.

The Second AA will not include any of the material which was in the original, but only such material as would be of interest to the hobbyist which was published between January 1950 and July 1952. Selection will be made in a similar manner to that for the first compilation, but any suggestions from readers will be considered.

Please do not consider this an invitation for orders—there will be plenty of time, and we will continue to reprint, if necessary, so long as anyone wants the book.
Complete facilities for Smaller Stations

The GATES 52-CS Studioette is ideally suited for smaller stations because it provides complete studio operation for present AM, FM and TV service — yet is often incorporated into a larger master control type of installation.

In design and construction, the GATES 52-CS Studioette is modern in every respect. At modest cost, it possesses many features usually found in only the most comprehensive and expensive consoles and is intended for service where fidelity, noise and distortion requirements are exacting.

facilities

The 52-CS Studioette provides four mixing channels, two for microphone service and two for turntables. Both turntable channels are provided with cue attenuators so that turntables, network or remote lines may be connected to an external cueing amplifier where desired. The Studioette will accommodate three remote lines with complete override and cue facilities.

Four amplifiers are provided; two 2-stage pre-amplifiers, one 4-stage high gain program amplifier and one 3-stage, 50 Db. gain, monitoring amplifier. Power supply is self-contained.

Outstanding Features

- Same high quality components as in all GATES speech equipment.
- Input transformers have multiple mu-metal shields.
- All transformers impregnated and moisture sealed.
- Shock mounted tubes in preamplifiers and first stage high level amplifier.
- Self contained power supply.
- Attractive steel cabinet tilts back for changing tubes, cleaning attenuators and reaching terminal strips.
- Under-chassis wiring quickly exposed by removing top.
- Large, illuminated 4" VU meter.

Write today for GATES SPEECH INPUT CATALOG where the functional block diagram and complete specifications of the GATES 52-CS Studioette will better acquaint you with the complete facilities provided in this versatile, yet inexpensive, speech input equipment.
Electrons probe the future

In 1927, Bell Laboratories physicists demonstrated that moving electrons behave like light waves, and thus launched the new science of electron optics.

Now, through the electron beams of the electron microscope and electron diffraction camera, scientists learn crucial details about the properties of metals far beyond the reach of optical microscopes or chemical analysis.

At the Laboratories, electron beams have revealed the minute formations which produce the vigor of the permanent magnets used in telephone ringers and magnetron tubes for radar. The same techniques help show what makes an alloy hard, a cathode emit more electrons and how germanium must be processed to make good Transistors.

This is the kind of research which digs deep inside materials to discover how they can be made better for your telephone system . . . and for the many devices which the Laboratories are now developing for national defense.

Bell Telephone Laboratories

Improving telephone service for America provides careers for creative men in scientific and technical fields.
Azimuth Film Calibration

MICHAEL RETTINGER

Regular maintenance of magnetic film and tape recorders requires a check of the azimuth of the head gaps. The author describes one method of making azimuth tracks with a high degree of accuracy, and explains their use in the field.

In making longitudinal magnetic recordings on tape or film by means of a ring-shaped magnetic recording head, and in reproducing these recordings on another head—the so-called reproduce head—it is important that the gaps of both heads make exactly the same angle with the direction of medium motion. If the angles are different, high-frequency losses occur, much as in the reproduction of photographic soundtracks when the light slit is tilted. The effect is known as the gap-tilt effect, or gap misalignment angle effect. Of course, when the same magnetic head is used for both recording and reproducing, the gap angle is of necessity the same, and there occur no high-frequency losses due to this effect.

In practice, the angle which the recording and reproducing head gap makes with the edge of the film or tape is 90 degrees. The angle by which a gap deviates from this normal angle is known as the gap tilt or gap misalignment angle. When recordings of short wavelengths are made, the misalignment angle must be very small, usually less than 10 minutes of arc, to reduce high-frequency losses to a practical minimum. For this reason it has become standard practice to align magnetic record and reproduce heads by means of a so-called azimuth film or tape, which carries a high-frequency recording made on a head, the gap of which has been aligned with a high degree of accuracy to be perpendicular to the edges of the film.

Figure 1 shows the decibel reduction in reproduce head output voltage as a function of the gap misalignment angle. It is seen that a number of secondary maxima and minima occur, at the high frequencies, for the gap angles shown on the curve.

To ensure that the gap of the recording

1 The term "lateral deviation" is sometimes employed for the term azimuth. See "Magnetic tape and head alignment nomenclature," by N. M. Haynes, Audio Engineering, June 1949.

Fig. 1. Curves showing reduction of output signal for varying angles of misalignment of recording and reproducing gaps. This chart is based on magnetic film speed of 18 in. per sec. For 1/4-in. tape, with a 15-in./sec. speed, the frequencies corresponding to the four curves are 15,000, 7500, 3750, and 1875 cps, respectively.

Fig. 2. Two-gap head—either gap usable for recording or reproduction—in an arrangement for adjusting azimuth accurately for recording of test films.

This azimuth film was at right angles to the edges of the film, a special head with two recording gaps was constructed. The head employed for the purpose is much like an ordinary recording head, except that the laminations were made symmetrical (see Fig. 2), so that the backgap of the head, when exposed, could also be used, either for recording or reproducing. To ensure that the poles of the laminated cores were in the same plane, the cores were lapped on a diamond lap.

In making the azimuth film, a recording was made by passing the film over the top gap of the head, as shown in Fig. 1. The film was then turned over, and reproduced on the bottom gap. By turning the film over, the angle which the sound track makes with the edges of the film is reversed, as shown in Fig. 3, and will be the same only if the gap angle is 90 degrees.

During reproduction the head was slightly tilted to the film. In the first trial, when the head was moved slightly one way from "normal" (the position which the head had when the recording was made), the output increased; while moving it slightly the other way from normal produced a decrease in the reproduce amplifier output. This showed that the gap of the recording head had not been at exactly right angles to the edges of the film. Several more recordings were then made, each at slightly different recording gap position, and a head position was found which, during the reproduction of the turned-over film, produced a decrease in reproduce amplifier output. It was at a slightly different gap position each way from the normal head position.

Another manner of checking correct azimuth with the azimuth head is to record, on the top gap, short sections of the high-frequency signal at different
Fig. 3. Tilt of magnetic striations on track is reversed if film is turned over.

head positions, say two one direction off "zero" azimuth, and two the other direction. If the head is set for correct or "zero" azimuth, reproduction of the recording, both on the top and on the bottom gap, should produce the same amount of level change for the different head positions used in recording.

Precautions

Several precautionary measures had to be employed to ensure the desired results. For one, the film had to maintain constant position in its travel over the head. This was accomplished by employing slightly tapered drums with a flange, so that the film was forced up against the flange in its travel, and thus was able to assume a constant position in its travel. It is also desirable in making an azimuth check to examine the film to make sure that both edges have the same length, that is, that the film is straight and not curved or "wavy". It may be noted that it is not necessary that the "sensitivities" of the two gaps be alike, although they were made equal for the head constructed by the writer.

There are two ways to check whether a head on a recorder is correctly positioned. By one method, the head is adjusted (while an azimuth film is being reproduced by it) until maximum output is observed on the reproduce amplifier output meter. On the other hand, if the head is not to be disturbed during the check, a so-called step-azimuth film may be used. This is usually made up of five sections of film of approximately equal length, say 20 feet each. The central section consists of a true azimuth film. The first section, when reproduced on a correctly positioned head, will give an output reading approximately 2 db below the reading which the central section provides. The second provides a reading approximately 1 db below that reading. The fourth section also produces a reading approximately 1 db less, while the fifth produces one which is 2 db below the reading which the central section provides. The step-azimuth film sections are usually marked thus: -2 db C.W. (clockwise); -1 db C.W.; 0°; -1 db C.C.W. (counter-clockwise); -2 db C.C.W. The postscripts C.W. and C.C.W. refer to the fact that the recording was made with the head misaligned clockwise or counter-clockwise respectively from the correct position. Thus -2 db C.W. means that, looking at the gap of the head from the position of the coating on the film to be placed on the head, the gap has been turned in a clockwise direction to such an extent that the output, referred to the correct head gap position output, is down 2 db. If maximum output results while any except the central section of the step-azimuth film is reproduced, the head requires realignment, preferably by means of an azimuth film. The step-azimuth film is therefore merely a tool to check installed heads.

To learn whether they are still correctly positioned. If maximum output results while the central section is reproduced, the head does not have to be disturbed at all, as it would have to if an azimuth film (not a step-azimuth film) were employed for the purpose.

It is possible to construct a head with a core width of 1° (the distance between the inside sprocket hole edges of 35 mm. film) so that the film can be used for a variety of purposes, such as determining the azimuth for the individual heads of a multiple track recorder, avoiding having to rework the film, etc. The wider the track may be made on another roll of tape or film, as by laying the print stock on the film carrying the signal track—coating against coating—and exposing the two to a high-frequency magnetic field. When the magnetic head used for the recording was correctly oriented, and when the print made in this manner on a correctly oriented head is reproduced on the same head, moving the head either way from "zero" azimuth should result in a lower reproduce amplifier output voltage than that obtained when the head is in the "zero" azimuth position.

"Microcheck"—Unmodulated Test Discs

Last June, in an article entitled "Phono Facts," Maximilian Weil proposed a check of the condition of a sapphire playback stylus which involved playing a few grooves of an unmodulated test disc—grooves which had not been played before—and observing the effect the stylus had upon the appearance of the grooves. This is a simple test, one which is readily available to anyone with a phonograph pickup and a tunable and an unmodulated test disc—but there's the catch. No such disc is available to anyone without the facilities to make it for himself.

The ease and efficiency of this test was appreciated by many readers—who quite naturally inquired as to where such a disc could be found. In most instances, we have suggested that it could be made for them by a local recording studio, but as it turns out, the cost has always been prohibitive.

In response to a request for help, W. Oliver Summerlin and Leon A. Wortman of Audio-Video Recording Company, 730 Fifth Avenue, New York 19, N. Y., have agreed to make such discs for anyone who wants or needs them. These discs are 12-inch single-track acetates, with one side completely recorded with unmodulated microgrooves, and they are available at the low cost of four dollars each, packing and shipping included.

Since these discs are cut with microgrooves, it is common if they would work satisfactorily on juke boxes for those occasions where a patron was willing to deposit a sum of money to secure a few minutes of silence—an idea which has doubtless occurred to anyone who has ever frequented any establishment where a juke box operated continuously, or nearly so.

16

AUDIO ENGINEERING • APRIL, 1952
A Twin-Channel Utility Amplifier

R. S. HOUSTON

Designed especially for use by a broadcaster in making remote pickups, this unit would find many applications in the experimental shop of many an audio engineer or hobbyist.

Catalog searching for an extremely portable remote amplifier with a dual output for feeding P.A. as well as broadcast lines brought to light many line units, but none which seemed to fit the primary requirement—small size. Hence it was decided to build one which would combine certain features peculiar to the operation intended, at the same time making it flexible enough to permit general use. The result is described here.

In the original design, it was intended to have two separate amplifier channels available for covering sports pickups where only one mike was needed. The second channel was intended to feed the P.A. with a separate program from another mike, which facility was supplied by the station. Since this setup was used frequently, it was felt desirable to combine the two channels, rather than have several pieces of apparatus to carry and clutter the limited working area. To allow the amplifier to be used for other small pickups using more than one mike, a switch was installed which allowed mixing the two input channels, thus providing a two-channel mixer, with both input signals mixed together and appearing at both output channels. To have a second channel instantly available in case of the failure of one, a changeover switch was installed to permit reversing the line connections to the two outputs. Thus if one line or output channel fails, it is a simple matter to switch over to the other, coordinating the switch with the studio.

Circuit Features

An inspection of Fig. 1 shows that all the tubes are of the miniature variety, all chosen for high gain. As a result it is possible to get the necessary gain with only three stages. Though it has never been accurately measured, the calculated gain is around 85 db which is adequate for most ordinary needs, with some gain to spare. The first stage operates in an entirely conventional manner, with the possible exception of the loaded input. While it is a matter for discussion whether or not this is necessary, the response is somewhat improved when working from ribbon mikes, and the stage is stabilized by its inclusion. If the two cathodes of the 6AG5's are to be tied together as shown, it is essential that they be well by-passed, to prevent interchannel coupling through the cathodes. Since the screens operate at the same voltage as the plate, the decoupling filter $R_{p}-C_{13}$ provides sufficient bypassing for the screens.

The second or mixer stage is a standard hi-mu triode with the two units in the tube operating independently. The essential difference is in the grid circuit. When the two stages are isolated, $R_{a}$ and $R_{b}$ have no function in their respective circuits other than to maintain a fixed minimum impedance in the grid circuit. However, when $S_{1}$ is closed, paralleling the grids of the 6J6, isolation resistors $R_{a}$ and $R_{b}$ are needed to prevent shorting out one input when the other is at minimum. Both grids receive the signal coming from the two input stages, and the signals are in phase through the rest of the amplifier. In later changes, a cathode coupled mixer stage was tried. This was accomplished by merely removing the cathode bypass, thus allowing the cathode potential to rise and fall with the signal. Since a signal on either grid will cause the cathode potential to change, any change will appear in both halves of the 6J6, and thus be amplified in both halves equally. However, the signal on the non-driven half will be out of phase with the driven half. This is of little consequence since the two outputs will not be feeding the same circuit. Another change in the grid circuit to eliminate the isolation resistors along with the modified cathode circuit are shown in Fig. 2, although this connection has a tendency to reduce bass at low settings of $R_{a}$ and $R_{b}$.

The two halves of the 12AU7 output stage operate independently into separate output transformers. The cathodes could have separate bias resistors if desired to insure complete circuit isolation, but sufficient bypassing will prove adequate and saves on parts. The heater of the 12AU7 is connected for 6-volt operation. The output windings are connected to the proper line through the operation of the locking-type key switch. In the

[Continued on page 44]
Design and Construction of Horn-Type Loudspeakers

WAYNE B. DENNY

Part II. Continuing the description of exponential horns suitable for home use in the never-ending search for clean bass. This corner model should be the answer to many a question as to "How to do it."

In last month's Article, the writer described a simple cabinet-type horn loaded speaker which is fairly simple to construct, and which provides excellent bass response, in addition to satisfactory high-frequency performance. There is some improvement to be expected, however, from a corner horn employing the same principles of construction, such as the one to be described here.

The second horn speaker to be described is depicted in Figs. 6 to 9, with the diagram and photographs showing the constructional features. The horn is vertical and opens into the upper corner of the room. This feature has the advantage that sound radiated from the horn avoids acoustic obstacles like chairs and other articles of furniture. Furthermore, the absorption by the ceiling is considerably less than that due to floors with carpeting. The space which is not used for the horn proper is used for shelves and this arrangement effectively hides the horn. The shelves add greatly to the rigidity of the structure.

A 12-inch driver is coupled directly to the throat of the horn and the speaker is entirely enclosed. Experiments over a period of weeks indicated that the low-frequency response was much smoother with the rear of the speaker entirely enclosed. Vents in the chamber resulted in muffled resonances and "boom." Ozite and ordinary air filters of the type used to warm air heating systems are attached to the walls of this enclosure and effectively damp out undesirable cavity resonances.

The horn walls of this speaker are constructed entirely of 3/4-in. plywood. The shelves, uprights, and the bottom are made of 3/4-in. plywood. (It is suggested that heavier woofle be used for the uprights to avoid warping which has been observed over a period of fifteen months.) Plenty of bracing eliminates undesirable vibration. Figure 8 shows one of the two damping plates which were constructed to keep the outside walls from vibrating. They consist of a piece of 3/4-in. ozite glued to the outside of the walls, covered in turn by pieces of quarter inch plywood screwed to the walls through the ozite. The resistance offered by the ozite under pressure eliminated vibrations in this area. The plates must be large so that the entire area does not vibrate as a unit. No internal cross braces were found necessary.

Speaker Ranges Required

This woofer is designed to be used in conjunction with additional speakers for the middle and upper frequencies. Tests have indicated that although the response of the woofer continues to rather high frequencies, the "presence" is decidedly enhanced by the use of a low cross-over frequency. The writer uses a cross-over of 300 cps.

An alternative arrangement used earlier by the writer consisted of a two-way speaker in place of the woofer. In order to avoid directional effects, a curved reflector was placed in the upper corner of the room directly above the horn to disperse the middle and upper frequencies into the room. Results were excellent though rather unusual. The apparent source of the sound was, as might be suspected, at the upper corner of the room. The arrangement was finally discarded partly because members of the writer's family objected to the "buzzard's nest" way up in the corner. It will be noted that the exponential "curve" is obtained by the use of straight boards, each one attached to two shelves.

Fig. 6. Constructional details for the vertical corner horn speaker, showing top and front views, together with section through the center of the unit.
In contrast to the other speaker described, this one is almost exactly exponential in shape. The results are better at extremely low frequencies. This is attributed to the shape and to the fact that the entire structure is larger.

In order to eliminate leaks, rubber weatherproofing strips were used to seal the corners of the horn. These strips are seen in Fig. 9. Their use eliminates the problem of precise fitting and also eliminates the transmission of vibrations from certain members of the structure to adjacent panels. The shelves, uprights, and other partitions are assembled with screws—nearly two gross.

Since this was originally an experimental unit, plywood was used to lower the cost. Obviously, solid woods or hard-wood veneers can be used to improve the appearance, but their use would, of course, greatly increase the cost.

Preliminary Model

The two horn speakers described are merely examples of what can be done. There is no doubt that other constructors can make further improvements by added refinements in design and construction. It is earnestly suggested that anyone who desires to construct a horn speaker should first make a cardboard mock-up. The model should incorporate all the main features of the desired structure. Its use permits the constructor to anticipate difficulties and to discard an inferior design before the speaker is started. The writer constructed several such models before building each unit. All but the last models were discarded for reasons of appearance, acoustic difficulties, or difficulties in construction. The added time spent with cardboard, shears, and scotch tape was a small price to pay for the effectiveness of the completed speakers. With one exception noted earlier, no changes were required to achieve good acoustic results. It's much cheaper to make mistakes on cardboard.

The writer's complete speaker installation consists of the two horn units described in this article, one bass-reflex unit, and high-frequency speakers. These several loudspeakers so diffuse the sound that visitors invariably ask, "Where is the sound coming from?" Like many others, the writer prefers diffused sound to that which comes from a point source.

In conclusion, two warnings should be given the prospective builder of a horn speaker. First, the improvement in low-frequency response is invariably accompanied by an increase in motor rumble. That phonograph motor which used to be "quiet as a mouse" is likely to take on the character of a roaring lion unless it is well made or unless some sort of noise suppression is used which is effective at the lower frequencies. Every audio enthusiast knows, improvement in one element of a reproducing system is likely to make deficiencies in other elements more obvious. The second warning has to do with the fact that the larger of the two units described in this article is assembled with screws rather than with glue. The reason is—well, do you remember the story about the man who built a boat in his basement and then couldn't get it outside?

British Radio Component Show, 1952

Grosvenor House, Park Lane, London, is the scene of the Ninth Annual Private Exhibition of British Components, Valves, and Test Gear for the Radio, Television, Electronic, and Telecommunication Industries for three days, April 7 to 9 inclusive.

This exhibit, organized by the Radio and Electronic Component Manufacturers' Federation, will present the products of over a hundred exhibitors, bringing new evidence of research by component manufacturers toward more reliable equipment for rugged atmospheric conditions, and with increased efficiency. The trend toward miniaturization is also shown by this year's exhibits.

Among the improvements to be shown are wire insulations and sleeving which have increased resistance to high temperatures, ceramic insulators of a variety of materials, and several grades of laminated plastics.

The show extends to assemblies, with new three-speed record changers in the forefront of interesting audio items, along with a new magnetic pickup of turnover design—possibly indicating that the British record industry will bring out records in more than one speed for domestic use.

That loudspeakers have an effect upon TV pictures is acknowledged by one manufacturer, who has wisely introduced one model of permanent magnet speaker which employs a totally enclosed magnet to reduce the external field. Another manufacturer is exhibiting a new pressure-type loudspeaker unit, together with vibration equipment for industrial research.

In spite of defense requirements, British manufacturers are still able to meet demands for civilian and export markets, although shortages are experienced from time to time in certain fields, and some items are confined to Government use.
The Problems of Low-frequency Reproduction

SAUL J. WHITE

A discussion of the characteristics which must be built into a low-frequency loudspeaker in order to maintain good efficiency with as smooth a response curve as possible.

A loudspeaker capable of extended low-frequency range without compromise of other values does not exist today. So-called "woofers" are often merely large cone speakers in which the frequencies above about 2000 cps are mechanically attenuated in the moving system, by mass or by compliance in the body of the cone. All that may be expected in most conventional woofers is this high-frequency loss, while a significant downward extension of frequency is rare, hence there is gained only some assistance to the work of the crossover network. This statement, however, excludes certain applications such as motion picture and professional installations, but here, too, there is room for improvement.

There are many antagonistic factors that harass the designer. The ideal low-frequency loudspeaker should fulfill the following requirements. It should have:

1. Uniform acoustic output from 20 cps up to any arbitrarily chosen cutoff.
2. High conversion efficiency throughout this transmission range, i.e., 50 to 100 per cent.
3. High power-handling capabilities.
4. Low distortion.
5. Excellent transient response.
6. Achieve above characteristics in an enclosure of reasonable volume.

While these specifications may appear reasonable to the average listener, the loudspeaker engineer is aware of the intensely conflicting operations of these objectives. No single transducer has been designed capable of satisfying all of the above requirements. As examples of the recalcitrant nature of the problem, consider that high conversion efficiency requires, generally, small mass, large compliance and negligible damping, but these qualities give poor response and poor power handling ability. Small mass demands a small area cone, hence inadequate radiation resistance and poor low-frequency output. Large mass vibrating systems produce lower values of frequency, but in order to suspend this weight adequately, the suspension is made stiffer, thus partially cancelling the low-frequency trend.

"Reasonable size" means that the speaker and its enclosure can be moved readily through the doors of the average home, yet low frequencies are associated with massive speakers, enclosures, or horns. The dimensions for 20-cps reproduction using a piston or a horn, are fixed by physical law. These dimensions reach terrifying proportions if the instrument is designed for a living room. Other problems and contradictions that stagger the designer will be brought out later, but as implied in the opening sentences, practical considerations impose many compromises upon the present day type of low-frequency loudspeakers.

Despite the low-frequency shortcomings, the speaker art has progressed tremendously in the way of good fidelity, and truly extended high frequencies. It is possible today to obtain 12-in. cones whose response extends to 10,000 cps without the aid of tweeters, whereas not so long ago 5,000 cps was the upper limit. In order to analyze low-frequency performance, it will be helpful to consider several basic formulas and relationships. First let us take up the parameters which establish fundamental resonant frequency.

Resonant Frequency

The relationship for mechanical resonant frequency of a diaphragm type moving-coil loudspeaker is revealed by

\[ f_r = \frac{1}{2\pi\sqrt{\frac{S}{M}}} \]  

where \( f_r \) is frequency of fundamental resonance
\( S \) is stiffness of system in centimeters per dyne
\( M \) is mass (weight) of moving system in grams.

The term \( S \) refers to the restraints against vibration which are developed in the cone-rim leads, and to a smaller extent, in the spider. Thus \( S \) denotes the "springiness" of the area which supports the vibrating mass, and is com-

* 82 Elm Street, New Rochelle, N. Y.
monly called the stiffness of the moving system. A large value of stiffness means that there is a large mechanical constraint against the movement of the cone in one direction, and a release of a correspondingly large amount of stored energy in the opposite direction. Thus an increase in stiffness, which gives certain desirable qualities to a speaker, raises the fundamental resonant frequency—usually undesirable in a woofer.

Equation (1) shows that because of the square root relationship, a rather large change in stiffness or mass is necessary to provide a substantial change in resonant frequency.

**Cabinet Volume**

If the speaker is enclosed in a simple non-vented cabinet, the total stiffness becomes the sum of the cone-rim stiffness and the cabinet stiffness, since the imprisoned air acts as an air spring and imparts additional mechanical impedance to the vibratory action.

Increasing the cabinet volume reduces the degree of this air stiffness, tending to lower the resonant frequency. But this effect grows progressively smaller because the stiffness of the cone rim remains large and is unaffected by cabinet volume. This explains why, beyond a certain cabinet volume, there is insignificant increase in bass. See Fig. 1. There can be no lower fundamental resonance than the free air resonance. The writer knows a number of experimenters who removed a speaker from a 4-cubic foot cabinet and built it into a wall, with disappointing results. The reason for this disappointment is the relatively high stiffness which is built into the cone suspension and over which there is no control. The cabinet stiffness can be relieved by increasing its volume. However, once all the stiffness is removed, for example by using a 4-cubic foot cabinet, then only the cone stiffness remains. The low-frequency performance is poor below the resonant frequency.

**Force Acting on a Diaphragm**

\[ F = Bi \text{ (classical)} \]

\[ F = B \times \text{ampere-turns} \]

From the designer's standpoint,

\[ F = B \times \text{volume of copper} \times \text{Amperes} / \text{volume of air gap} \]

where \( F \) = force acting on voice coil

\( B \) = flux density in air gap

\( l \) = length of copper wire in voice coil

\( i \) = current through voice coil.

The above formulas show the force acting on the voice coil in the presence of a given signal, but do not yet represent the acoustic output. In fact, they do not necessarily indicate the force that moves the cone because of coupling losses between the voice coil and the main area of the cone. Equation (2) expresses a coupling factor between voice coil and gap flux, and is involved in the following equation for acoustic output:

\[ P = \frac{D^2 R E_s}{10^9 Z_m Z_a} \]

where \( P \) = average acoustic output power in watts

\( D \) = electromechanical coupling factor

\( R_s \) = radiation resistance on cone

\( E \) = rms volts across voice coil

\( Z_m \) = mechanical impedance

\( Z_a \) = electrical impedance.

The term \( D^2 \) converts ergs per second into watts. The term \( D \) is similar to the force \( F \) in equation (2) and involves gap constants such as flux and amount of copper. The term \( R_s \), or radiation resistance, requires some explanation.

**Radiation Resistance**

Direct-radiator speakers are inherently poor radiators at low frequencies because of the low radiation resistance which is presented by the atmosphere. Although a cone may have a large vibration, it does not follow that it transmits sound energy to the air. It can have an amplitude sufficient to rupture it, yet the sound propagated is negligible.

This is the case when the diaphragm is small compared to the wave length of sound it is trying to propagate. For instance, at 200 cps a 12-in. cone is an efficient radiator, but at 20 cps even a violent movement produces practically no 20-cps fundamental acoustic energy.

The listener hears the harmonics generated because of the large distortion present at this frequency. The fundamental frequency is unheard because there is insufficient diaphragm surface acting on the atmosphere.

The diaphragm acts in conjunction with air, which is its load. In order to deliver the necessary acoustic energy to the air it is necessary to employ a definite number of air particles to propagate the energy. This involves a definite reaction between diaphragm and atmosphere and fixes the minimum dimensions of the cone. If a diaphragm is too small for the frequency of its vibration, it has only slight resistance opposing it and it is not possible to impart all the energy of the diaphragm to the air. This is the condition of inadequate or high radiation resistance.

The atmosphere is capable of absorbing a large amount of cone energy if the cone is large relative to the wavelength, and efficient transfer of energy takes place. Thus more sound is produced with smaller cone excursions. This is the condition of adequate or high radiation resistance. Therefore, loudness at low frequencies can be increased by forcing more air particles in contact with the diaphragm. This is accomplished by using a large diameter cone, in the case of direct radiators, and by using a slow flare and large mouth in the case of horn speakers.

Looked at in another light, the entire atmosphere is the load for the loudspeaker. Where there is no load, there can be no absorption of energy. Incidentally, the listener's ears are a part of, and within this load.

If the acoustic output is to be independent of frequency, which is required for uniform response, it is of course required that the various terms of the expression in equation (3) be independent of frequency. Unfortunately, \( R_s \) and \( Z_m \) are both frequency dependent, and thus the requirement for linear output is difficult to attain at low frequencies. For frequencies at and below resonance, \( R_s \) and the radiation resistance is proportional to the square of the frequency. This term shrinks as frequency drops, hence efficiency falls off rapidly. This is seen from Fig. 2, which shows the peak-to-peak excursion for 1 acoustic watt output. The chart indicates that for a given cone diameter, a decrease of one octave increases the excursion by a factor of four.

\[ Z_m \text{ term for mechanical impedance.} \]

[Continued on page 47]
New!

"The Super Tweeter"

RALPH P. GLOVER and KARL KRAMER

Available at last—an accessory unit which provides smooth high-frequency response, including that top octave so hard to obtain, even with a good two-way system.

AFTER TWO YEARS of production and extensive public experience with the G-610 Triaxial, a three-way loudspeaker with an unusually smooth and greatly extended high-frequency range, it is possible to draw some definite conclusions, important to everyone interested in truly high quality reproduction, conclusions which have fundamental significance apart from the merits of this particular loudspeaker. They are, as we see them:

1. The reproduction of the middle-to-extreme high frequencies with smoothness and low distortion is very much worthwhile; the condition is essential if we are to take full advantage of the potential contribution of the "highs" to realism in recreated sound.
2. The advantages of using a special high-frequency unit for the top end of the frequency range are very definite and readily appreciated when an opportunity for careful comparison of high-quality systems is presented, being evidenced by the elimination of these shortcomings of high-end extenders which over-reach sound design principles in their attempt to cover too wide a frequency range: Lack of "separation" of orchestral instruments; "smeary" reproduction of vocals; "throaty" or "nasal" coloration of the music; "wiry" roughness in high fundamental and overtone structure; perceptible "ringing" background noise. In the one case there is a definite satisfactory sensation of "transport to the original," in the other a feeling of the interposition of a mechanical device with superficial attributes of "presence."
3. A perhaps not-to-be-lived dividend of the "clean" high end has turned up in respect to noise and system distortion. A loudspeaker system with a smooth (though well extended) high-frequency range has been found to be substantially more tolerant of distortion and of record, tape, and tube noise present in the incoming signal. Distortion from the source is not magnified and harshened; the noise is more "silky" and less typically colored.
4. All of these real and undesirable effects can be eliminated by substituting a cleanly-extended high-end for the offending one. This can be done with virtually no mechanical difficulties, and with the simplest of wiring changes, by means of the accessory high-frequency unit and network described in this article; cost is only about one-third that of an upper-bracket 15-inch coaxial speaker.

As illustrated in Fig. 1, the RP-302 High-Frequency Unit is basically an externally modified version of the top (third) acoustic channel of the G-610 Triaxial, designed into a streamlined case with removable bracket for top-of-cabinet mounting, Fig. 3, and arranged so that it can be installed flush on the
front surface of a cabinet or baffle, as in Fig. 2. The unit is intended to serve (1) as a moderate cost acoustic replacement (mechanical and electrical changes in present speaker equipment are unnecessary) for the h-f end of loudspeakers with insufficiently extended, deficient, or distorted h-f response, and (2) as the third or top channel of a three-way divided system being built from "scratch."

Figure 4 is an exploded view of the "super tweeter" showing how the unit comes apart for flush mounting. The three screws are removed from the front, after which the horn piece can be inserted into a 1-1/16-in. diameter hole in the panel. The driver unit is then reassembled to the horn and the cover acts as a clamp from the rear to hold the assembly tight to the panel. Figure 3 shows the unit in place, flush mounted on the cabinet.

Electrical Connections

As will be seen from the block wiring diagrams, there are several ways of applying the "super tweeter" to existing loudspeakers or systems:

1. Eliminate highs above 4000 cps from the existing loudspeaker or system electrically by means of a crossover network such as the A-402; feed the RP-302 from the crossover network, so that it alone is reproducing in the range above 4000 cps. See Fig. 5, (A) and (B). (This method has outstanding advantages since it eliminates rough and distorted high-end acoustic output from the original equipment as well as improving the efficiency and extending the range of the h-f response. If you think your present coaxial or divided two-way system is as good as it can be, try this.)

2. The high frequency unit may be bridged across the input to the present speaker with a 1-nf condenser in series with the unit as shown at (C) and (D). (The series condenser is essential here to keep low frequency power out of the h-f unit, which may be damaged otherwise. This method is useful for extending h-f range and improving efficiency and gives good results with many speakers.)

The efficiency of the super-tweeter is appreciably higher than that of most commercial speakers, and an L-pad is usually desirable between the network and the unit to adjust the h-f balance.

Technical Data

The RP-302 super-tweeter has an impedance of 16 ohms, and the voice coil is wound with aluminum wire to minimize mass. The phenolic diaphragm works into a high-frequency horn designed in accordance with the Hypex formula. The frequency range extends from 3500 to 18,000 cps, and the coverage angle is useful over 120 deg. The power handling capacity of the unit is adequate for a system of 30 to 40 watts output, when used with the A-402 Cross-over Network. Obviously, if a test signal at this level were applied to the unit over the high-frequency range, damage would result, but with normal power distribution of speech or music, the super-tweeter is capable of handling the output of a high-power amplifier.

The A-402 Crossover Network is of the constant resistance type, in a parallel configuration. It consists of two inductances and two capacitances, and has an insertion loss of less than 0.25 db in the pass band, and with an attenuation of 12 db per octave each side of the 4000-cps crossover in the two channels.

Its impedance is 16 ohms, to match the speaker unit.

(Errors Note: Over a year ago, one of these units was sent to us for our trial in the field. On the evening of the day it was received, it was connected to our present two-way system, consisting of a 15-in. woofer in a corner cabinet, shown above, with an 8-cell high-frequency horn of excellent performance. The super-tweeter adds considerably to the entire installation, providing the extra bit of brightness that aids in establishing the illusion of reality. The improvement is definitely noticeable, and all who have heard it have been anx-

Fig. 3. The simplest mounting—on top of the existing cabinet.

[Continued on page 52]
Audio in the Home

William C. Shrader*

Custom assembled home music systems offer better sound quality, provided the various components are selected with a view to their ability to work well together.

Since these articles are intended primarily for a large, new group of readers who are interested in music and high fidelity but who are not engineers, we might note here that certain words commonly used by both have completely different meanings for engineers and for musicians. Flat, for instance, means to a musician a half step lower than any given tone or that a certain tone is not up to pitch. The engineer uses it to mean that an amplifier has uniform intensity throughout its range. Another two-meaning word is resonant. A voice teacher rejoices upon discovering a singer with resonant timbre, but a sound engineer grits his teeth when a loudspeaker is resonant, because then it makes the loudness of some tones greater than others. A musical tone is produced by regular vibrations of the air. (Irregular vibrations produce noise.) A certain number of vibrations (or cycles) per second are a given tone. If we call 261 cycles per second middle C, more vibrations per second produce a higher tone and less a lower one. It might also be worthwhile to state that cycles have nothing to do with the quality of sound, but effect only its pitch. As an example, middle C has a different character of sound when created by an organ pipe than when it is created by a trumpet, but, in each case, the air vibrates regularly 261 times a second. So much for this month's educational section.

In this article, we shall concern ourselves with a group of components which sell in radio parts houses for about $250 and which equal the performance of most $500 or $600 commercial con-

soles. One of the reasons we choose these parts in preference to the console is that cabinet shops often charge ridiculous prices. Cabinets represent as much as $200 to $300 in trade-name sets, and this is probably one of the reasons they are so expensive. A custom set, on the other hand, can be housed in utility cabinets for about $100. We are able to choose components that work well together, and because they are separate they adapt themselves more readily to home installations than any mass produced console. Those who demand and can afford fine cabinetry can adapt the equipment to the style of cabinet that best blends with the decor of their living rooms. It is important to point out, however, that merely picking up an amplifier here, a speaker there, and a radio tuning device somewhere else is not likely to assure satisfaction. It is necessary to obtain an amplifier that is free from hum and that has flexible tone controls that do not induce

* 2803 M Street, N.W., Washington 7, D. C.

Either built-in or as separate cabinet units, a well planned system can still be attractive. Photo at the left by the author; below by Electronic Workshop.
too much distortion into the system, and to house the speaker in a proper acoustic chamber. In only one of the presently available commercial consoles has any attempt been made to house the speaker in an acoustically correct manner, and this model starts at $750.

The manufacturer of a conventional console designs his set for the housewife mainly. When she goes forth to buy a radio, she wants one that will look well in her living room, uses space economically, and can be operated with push-button ease. She usually goes home with a gleaming piece of hand-rubbed furniture that cost several hundreds of dollars and which, incidentally, contains a radio which she may or may not have heard. The genuine music lover or high-fidelity fan who, until recently, was thought too small a segment of our economy to court commercially, exactly reverses the housewife's preferences, putting a premium on sound rather than sight. He is not likely to want short-wave, push buttons, or fancy cabinets, and he cares little for a lot of gadgets which often don't work well anyway. His special interest is in equipment that can produce an octave above and below normal radio fidelity, and when he is shown or told about it, his usual reaction is, "Let me hear it."

Cost vs. Quality

In most cases, a high fidelity buyer can purchase a basic system at 40 per cent off list prices, and this is a substantial saving for good equipment. People often wonder, "What is the most important component in a system? Do I want a $150 amplifier and a $20 speaker? Or, do I want an inexpensive amplifier with an expensive speaker? Where can I compromise or where will a few more dollars do me the most good?" The primary consideration is balance. To obtain a like number of octaves must be added each way from approximately 800 cps (cycles per second). The addition of a tweeter or high-frequency speaker alone can cause unbalance and impair rather than improve results. Similarly, the addition of a folded horn or large bass-reflex cabinet may cause the speaker to sound dull and dead if a like increase is not made in the high register.

Since music reproduction in the home is far from perfect, there are many conflicting approaches to the selection of components, and there are as many dogmatic salesmen so oversold on particular items that they are not open to other opinions. In visiting your dealer's salesroom, you may find this approach, and you will do well to bring along your own records and insist upon hearing them at volumes more normal to a living room than to a boiler factory. In demonstrations of their own products, manufacturers will use compliments that most flatter them, and these components are accepted by engineers only after having been proven in the field, not through well-known advertising blarney.

We would like to commend the consumer testing laboratories, whose contributions have been a great asset to our field in general. It is obvious that most products recommended by them are good. However, since they buy and test only a few units of a particular brand, these particular units may not necessarily reflect a true picture of that brand. We realize, of course, that they have neither the money nor the time to do otherwise. The performance, over a period of time, of hundreds of items gives a truer picture of a product than can be derived from a few isolated units. It is imperative to custom dealers that components be free from excessive servicing requirements, because these dealers work in close conjunction with the customer, even after he has purchased his equipment, and they guarantee its performance. This close contact quickly shows any change for the worse in the quality of a line of equipment. A brand with uniform quality of units, few breakdowns, and ease of installation in the field may be much superior to a recommended component whose frequency is a db better.

Since we are confining ourselves to a $250 system in this article, we can begin with the record player portion, as its price is pretty much a fixed one. Most people prefer record changers. One that is free from hum and rumble and has a constant speed will cost from $35 to $40. With two good, 

Bookcases are often adaptable—as shown here—for housing all the necessary equipment. Tuner, amplifier, record player, and adequate speaker space are provided in this attractive installation.

[Continued on page 54]

AUDIO ENGINEERING • APRIL, 1952
IRE SHOW REVIEW — 1952

HARRIE K. RICHARDSON

When the doors closed on the night of March 6, signifying the final curtain of the 40th annual convention of the Institute of Radio Engineers, more than 30,000 visitors had passed through the doors of New York’s Grand Central Palace to establish the 1952 Radio Engineering Show as the most lavish electronic exhibit of all time.

Displays approaching the four-hundred mark brought the value of equipment on exhibit well into the millions. So much for the affair from a dollar-and-cents viewpoint.

From where this observer sits, the real and lasting value of the I.R.E. get-togethers has always lain in the great amount of technical information available to those visitors whose yearly attendance is based on a sincere desire to become better read and better informed in the industry which provides their livelihood. In the past, the availability of such information has been beyond question—however its accessibility has been one of those things we don’t talk about. This year we not only talk about it—we shout about it to the skies.

Aside from the increase in exhibitors and in attendance, the 1952 I.R.E. conclave will cement its place in history because of its great advances in the handling of organization in general, with particular emphasis on the manner in which attendance at technical sessions was expedited. Public relations was another aspect of the event which received great improvement over efforts of previous years.

Both satisfaction and reluctance prevail in the mentioning of a few names—George Bailey, Will Copp, Woody Gannett, Haraden Pratt, and Lew Winner—for their part in motivating this creditable move forward. Satisfaction because such mention gives credit where credit is deserved—reluctance because it withholds, consciously but not intentionally, equal credit which is due so many others whose efforts were no less impressive.

A similar conflict brings forth mention of but a few of the hundreds of excellent exhibits:

Altec Lansing Corp., giving full recognition to the professional aspect of the show, emphasized industrial amplifiers.

Amperex Electronic Corp., occupying the same prominent mains-floor display space as in previous years, gave full meaning to the familiar slogan—"Something new has been added." Recent additions to the Amperex line have broadened the company's range of products, and now includes power tubes for almost every transmitting and industrial application. Although the unit was shown at last year's Audio Fair, this was its first appearance before an IRE group. The hit it made in both instances leaves no doubt that Berlant has created another winner. Also on display was the Network model's famous forerunner, the original Concertone for home and professional use. Both models were demonstrated in conjunction with the new Fisher "laboratory standard" amplifier (see Fisher review).

The Daven Company, as might be expected, came through with an impressive display of attenuators and test instruments a limitless variety of applications. Clearly established was the fact that Daven, today as in years gone by, is unsurpassed in the manufacture of precision components.

Fisher Radio Corporation devoted the bulk of its display to an introductory showing of the new Berlant Concertone network-model tape recorder, for which Fisher is exclusive Eastern distributor. Another new item shown was the recently-announced Fisher "labo-


"Barker & Williamson, Inc. attracted attention with a complete display of B & W test equipment and in the extensive line of unique coils and components which the company makes available to manufacturers of electronic equipment. B & W, because it offers test equipment of excellent quality at moderate price, has assumed a position as one of the country's leading suppliers of precision instruments.

British Industries Corporation captured the interest of audio hobbyists and production engineers alike with a varied display which included Garrard record changers, the Leak "Point One" amplifier, Wharfedale speakers, and Ervin Multi-Core solder. Although Garrard, Leak, and Ervin are pretty well established in this country, Wharfedale is just beginning to win its spurs. Present indications are that those spurs, when won, will place the name Wharfedale in a position of unquestioned prominence in the high-quality speaker field.

The Daven Company, as might be expected, came through with an impressive display of attenuators and test instruments for a limitless variety of applications. Clearly established was the fact that Daven, today as in years gone by, is unsurpassed in the manufacture of precision components.

Fisher Radio Corporation devoted the bulk of its display to an introductory showing of the new Berlant Concertone network-model tape recorder, for which Fisher is exclusive Eastern distributor. Another new item shown was the recen-

"Barker & Williamson, Inc. attracted attention with a complete display of B & W test equipment and in the extensive line of unique coils and components which the company makes available to manufacturers of electronic equipment. B & W, because it offers test equipment of excellent quality at moderate price, has assumed a position as one of the country's leading suppliers of precision instruments.

British Industries Corporation captured the interest of audio hobbyists and production engineers alike with a varied display which included Garrard record changers, the Leak "Point One" amplifier, Wharfedale speakers, and Ervin Multi-Core solder. Although Garrard, Leak, and Ervin are pretty well established in this country, Wharfedale is just beginning to win its spurs. Present indications are that those spurs, when won, will place the name Wharfedale in a position of unquestioned prominence in the high-quality speaker field.

The Daven Company, as might be expected, came through with an impressive display of attenuators and test instruments for a limitless variety of applications. Clearly established was the fact that Daven, today as in years gone by, is unsurpassed in the manufacture of precision components.

Fisher Radio Corporation devoted the bulk of its display to an introductory showing of the new Berlant Concertone network-model tape recorder, for which Fisher is exclusive Eastern distributor. Another new item shown was the recently-announced Fisher "laboratory-
standard audio amplifier. Together the Concertone and the new Fisher amplifier provide an impressive example of high-quality audio in action.

Gates Radio Co. came up with an exhibit that was a broadcast engineer's dream—everything from an FM relay transmitter to a sound effects console. The latter—a three-table job with all the familiar trimmings, not to mention a few that were shown here for the first time, will permit a single sound-effects man to perform 99-99/100 per cent of the acting on the average Western.

General Electric Company, following through on the foothold it has established in the high-quality audio field, devoted an impressive portion of its comprehensive exhibit to the GE variable-reluctance pickup and the GE 1291 loudspeaker. Both of these items, the VR pickup particularly, were among the first to result from the demand for fine audio performance in the moderate-price range. They still create more than casual interest wherever exhibited.

Jensen Manufacturing Company made full concession to the fact that its products must be heard as well as seen in order to be fully appreciated. In a sound room adjoining the Jensen display space, company representatives conducted a continuous demonstration of the famous Jensen G-610 Triaxial speaker. High-quality tape recordings, amplifying equipment of matching caliber, and the G-610 combined to produce an over-all audio performance that was truly magnificent.

James B. Lansing Sound, Inc., Magnecord, Inc., and McIntosh Engineering Laboratory conducted a joint display which was built largely around a demonstration of binaural recording. Great indeed is the loss of those who missed this exhibit. Impeccably recorded tapes were fed from a binaural Magnecorder through McIntosh Type 56-W-2 amplifiers into two Type 1094 Lansing corner speakers, creating an aura of reality that surpassed illusion. This display also was the introductory scene for the new Magnecorder (see New Products, page 42)—a home-music-system version of the professional Magnecord series.

Herman Hommer Scott, Inc. chose the occasion of the show to introduce an advanced version of the company's well-known Sound Level Meter. Although its original prominence was in the audio field and was based largely on the Scott Dynamometer, the Scott organization today is expanding rapidly in the field of industrial electronics.

Precision Apparatus Co., Inc., in addition to showing its complete line of test instruments for radio and TV servicing, introduced a new 5-inch oscilloscope which will have many applications in the laboratory and on the service bench. Excellent electrical design and rugged construction combine to make the new Precision scope one of the finest in the moderate-price range.

Presto Recording Corporation dramatized graphically the extent to which its line of recording and playback equipment has been expanded to meet the demands of today's market. Presto, not too long ago a leader in the disc field only, is now one of the major manufacturers of tape equipment. Engineers and audio hobbyists alike were deeply impressed by Presto's newest developments in the science of tape recording.

Radio Electric Company, Inc. fascinated industrial sound engineers with a display of speakers for every conceivable type of paging and public-address application. Design features and constructional details of various Bacon models were clearly shown by means of cuta-
Why Not Use Your Present Tuner?

Ulric J. Childs*

Simplified instructions which will make it possible for you to attach that new amplifier to an existing tuner as one of the first steps in assembling a high-quality home music system.

The first step in the audio education of the average individual comes when he hears music at the home of a friend who has already graduated from the ranks of ordinary radio-phonograph listeners. If the friend (and it is more likely to be friends these days) has a separate amplifier and speaker at least—and probably also a high-quality magnetic phonograph pickup—our individual may very well come to the conclusion that his own home would be a pleasanter place if his records and radio sounded a little more like real music and didn’t pull in so short a time.

Right at the beginning most of us are not willing to spend a great deal of money, but a little inquiry quickly establishes the fact that the first requisite is a separate amplifier. A visit to the nearest dealer with a sound showroom removes any doubt that even a moderately priced amplifier is an improvement on the usual radio-phonograph’s audio section, especially when a separately housed speaker is added. Commercial all-in-one instruments are made and purchased more as furniture than as musical instruments; our hero is one of the growing number of people who have decided that the ear is as important as the eye.

Not wanting to spend anything more than necessary, it is a logical decision to use at least the tuner portion of the present radio instead of buying a new tuner. As long as the radio tunes in stations satisfactorily and has no other glaring faults (except inadequate sound), there is nothing wrong with the idea. But then the question arises: How do I connect the output of the receiver to the amplifier input? In this article we shall give several good methods. All of them are equally useful for connecting television receivers to an amplifier—an especially good idea since most TV sets have very poor built-in sound sections—and whether the set is AM, FM, or both makes no difference.

The first requisite is to discover whether the receiver is a transformerless type. To do this pull out one or two of the tubes. If the others do not light, the set is transformerless. Another good clue is to note the tube numbers. If any of them begin with numbers over 14 (50L6, for example, or 3525), the set is transformerless. If so, do nothing until you buy and install an isolation transformer from your radio parts supplier. This makes connecting the set to an external amplifier safe: otherwise you may get a nasty shock each time you touch the amplifier, or you may damage it. The transformer is inexpensive and easy to install according to the directions that come with it or the advice of the salesman.

Whatever method used for the connection, you will need a length of shielded, insulated single-conductor cable. Obtain from your radio parts dealer a piece long enough to reach from the radio to the amplifier, with a few inches to spare. At the same time buy a plug of whatever type is needed to plug into the amplifier input. Solder the plug to one end of the cable and prepare the other end by removing about two inches of the outer insulation and about an inch of the shielding and a half-inch of insulation on the wire. The cable end will now look like Fig. 1.

The quickest and easiest way to make the connection is to use the volume control of the receiver as the connection point. When the chassis is removed from the cabinet, the volume control appears as in Fig. 2, looking at it from the back, the shaft facing into the paper. There may be additional terminals, but we are interested only in the closely grouped set of three.

The center terminal (A in the figure) is ordinarily connected to one end of a capacitor (condenser), the other end of which is soldered to one terminal of a tube socket. There is also usually a resistor soldered to the same tube-socket terminal. Unsolder the capacitor lead from the socket terminal and let it hang free temporarily. Now, with a short piece of wire, connect the tube socket terminal to some point which is obviously touching the chassis metal. This silences the radio’s built-in speaker.

Twist together the bare wire at the end of the prepared cable and the free wire of the disconnected capacitor. Flow some solder over the joint, then tape it up with electrical tape. Next, find a way to anchor the cable as it leaves the chassis to prevent it from moving too much and breaking the capacitor lead. Use tape, string, or any other insulated method of anchoring to some chassis hole or secure terminal.

The last operation is to connect the exposed shield of the cable to the volume control terminal marked B in Fig. 2. Use ordinary hookup wire but be sure it is well soldered to the cable shield; do not remove whatever is already connected to the volume-control terminal. Be sure to find the right one—the terminals may not be pointed up as in the drawing, so orient the paper until the drawing agrees with the fact. Probably this terminal is connected to the chassis. Tape up the connection as necessary to make sure the shield and the wire will not touch any other point of the circuit. The receiver will now operate as usual, but if the amplifier has its own volume control it is best to use it only and leave

[Continued on page 45]
The easy way the BC-2B Consolette handles is due in great measure to the careful attention RCA engineers have given to construction details—and to a number of unique operating features (not found in their entirety in any standard console). Some of these advantages are pictured on these pages.

For example, see how easy it is to get at the amplifiers and components. Note how every inch of wiring can be reached without disturbing the installation. See how the console fits snugly into the control room—unobtrusively. See how the styling matches other RCA audio and video equipments.

Based on more than 25 years of experience in building studio consoles, type BC-2B is in our opinion a high point in console design. The instrument includes all essential elements needed by most AM-FM and TV stations. And every feature has been operation-proven—many in RCA deluxe custom-built equipment. Type BC-2B is available at a "package" price!

For details, call your RCA Broadcast Sales Representative.

Type BC-2B is styled to match RCA video equipment—like this familiar video console. And it's styled to match other RCA audio equipment, too—like this master switcher, for instance.
All external connections are made to two terminal blocks. To get at them, just lift the cover.

Now, reliable interlocking push-button switches are leaf-type and cam-operated.

Improved, faster-operating speaker relays eliminate key clicks and audio feedback.

new consolette

Low height, and 30-degree sloping front and top offer maximum studio visibility. You can install the BC-2B tight up against your studio window. There are no rear connections.

RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT
CAMDEN, N.J.
Equipment Report

Altec Lansing A-333-A Amplifier with A-433-A Preamplifier and Control Unit

Continuing the tests upon commercially available home music system equipment, the second of this series is the two-unit combination built by Altec Lansing under the numbers A-333-A and A-433-A. The former is a three-stage power amplifier, using a 6SJ7 as a voltage amplifier stage, followed by a direct-coupled 6J5 cathodyne phase inverter, followed in turn by a pair of 6L6's as tetrodes. Probably because of the unique method of maintaining the screens at a fixed potential difference below the plate supply, this amplifier measures with the lowest distortion encountered to date, arriving at 8 per cent IM distortion at a power output of 22 watts, and with less than 2 per cent IM distortion up to an output of 15 watts.

On the debit side of the report must be listed the difficulty of removing the protective screen cover on the power amplifier for such purposes as changing tubes, and the fact that it is difficult to use the amplifier with the screen cover removed because one apron of the chassis is actually a portion of the cover. However, amplifiers serve most of their time working, rather than lying on the service bench, so this difficulty is of minor importance.

The preamplifier-control unit is well designed, and the equalization provided for magnetic pickups appears to be well chosen, particularly in view of the present general popularity of LP records. Three positions of equalization are provided—the first with a turnover frequency of 300 cps and the second with a turnover frequency of 800 cps. Both of these positions are provided with a "flat" high end—that is, with no roll-off. The third position has a turnover of 500 cps, and in addition has a roll-off designed to match the LP curve. Thus it is not necessary to adjust the tone controls to achieve the roll-off required for LP records, although the tone controls may be used to modify the curve as desired, as well as to introduce the required roll-off to match records being played on positions 1 and 2.

Gain is adequate for any standard magnetic pickup, and for any tuner likely to be used with a home system, as shown in the table of input signal voltages.

**Signal Input Voltages**

<table>
<thead>
<tr>
<th>Input</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio</td>
<td>.0157</td>
</tr>
<tr>
<td>Spare</td>
<td>.0024</td>
</tr>
<tr>
<td>Phono</td>
<td>.017</td>
</tr>
<tr>
<td>Pwr. Ampl.</td>
<td>.58</td>
</tr>
</tbody>
</table>

for 1-watt output

- 1000 cps, volume control maximum, tone controls "flat"

Schematic of entire Altec amplifier. Unit at left is the A-433-A preamplifier and control unit; at right, the A-433-A power amplifier. The two units are connected by means of two cables, with a.c. circuits in one, d.c. and audio circuits in the other.

32 AUDIO ENGINEERING • APRIL, 1952
PICKERING RECORD PLAYING EQUIPMENT

For flawless reproduction of the works of the masters

Pickering diamond stylus pickups and related components are the exclusive choice of musicians and lovers of music who insist upon the finest. Engineers acknowledge Pickering audio components as the best available. In every test and performance comparison, they demonstrate their superiority; recreating all the music pressed into modern recordings with the fidelity and realism of a live performance.

Pickering components are created for listening pleasure by Audio Engineers who know music and who know the tastes of discriminating listeners.

Pickering diamond cartridges have no equal. The wear and fracture resistance of the diamond styli in these cartridges is many times greater than that of styli made of sapphire, the next hardest material. Because resistance to wear preserves the precise shape of the stylus point, the life and quality of your valuable record collection is insured.

Don't impair the musical quality of your priceless records.

Use Pickering diamond stylus cartridges ... they not only wear longer but, more important, they preserve the musical quality and prolong the life of your record library.

By all measures, Pickering diamond stylus cartridges are more economical.

PICKERING & COMPANY, Inc.
Oceanside, L. I., N. Y.
Broadcast Short-Cuts

A series of simple but useful suggestions as to methods of solving day-to-day requirements for "new inventions" in a broadcast station.

In stations using standard speech input consoles, it is generally necessary for the engineer to operate the mike switch for the announcer. Obviously this means extra work for the engineer, who in many cases is already pressed with other work, even if only turntables. It is also desirable from a production standpoint to have the announcer operate his own mike. In many cases it is difficult to install such a switch or control without mutilating the console circuits and without resorting to a relay. The circuit shown in Fig. 1 will give the desired control, and in addition will provide a positive talkback to the control room to enable the announcer to give instantaneous instructions.

If desired, a mike socket may be installed on the announcer's table, and the mike plugged into that, then another cable would plug in to the mike socket in the wall. In an alternative plan, a lead from the socket could be run out to the switch, which can be mounted either on the wall, or on the table, or even placed in a box, so as to make it semi-portable. On one throw of the key switch, the mike shorting contacts are opened and the speaker relay and warning lights are energized. On the other throw, the mike is transferred to the talkback circuit. This will need a preamplifier or other high-gain amplifier to operate into the audition system of the station. All of the mike's from other studios can be brought in parallel to this input, since they are all terminated by resistors, rather than being shorted. If desired, the shorting contacts can be connected into the console right at the output of the pre-amp. This would eliminate some of the noise attendant with switching, and also eliminate much of the stray pickup from a long unbalanced line to the shorting switch. The audition circuit can be connected as above, or the output of the preamplifier can be run out to the switch and used in the circuit as shown, in which case there will be no need for the pre-amp in the audition circuit.

In the operation of remote studios in a city near the main studio, it was discovered that the line loss was too great to permit efficient program transmission. By coincidence, the transmitter was located approximately half-way between the two locations. A booster amplifier was installed at the transmitter, and the lines run from the remote location to the transmitter, and from there to the studio. For various operating reasons, it was more efficient to handle the line from the studio, rather than mix it at the transmitter. Since the line was used for transmission of programs in both directions, as well as for talking, there was the problem of reversing the booster amplifier.

To simplify the problem of switching, a simplex arrangement was used to operate a reversing relay, as diagrammed in Fig. 2. The control voltage was placed on both lines, and grounding at either end would reverse the direction of transmission. The relay was arranged to have the normal direction of transmission toward the studio from the remote point. This would ensure continuity in case of control-voltage failure. To use the line as a talk circuit, it is merely necessary to install a switch accessible to the phone, and then use it in the conventional "push-to-talk" manner.

Oftentimes while doing work on high-voltage circuits, it is necessary to operate with the doors open for observation or adjustment and, of necessity, the interlocks are shortened. In many cases this is done with merely a couple of clips across the switch or contact on the door. Or, in the event it is necessary to open several doors, the whole interlock string is shortened. Such devices, if they do not prevent the doors from being closed

Fig. 1. Switching arrangement to permit microphone to feed program or talkback circuit under control of announcer.

[Continued on page 58]

Fig. 2. Reversing circuit for repeater amplifier which permits two-way transmission under control of either end of circuit.
HARVEY again leads the field with the FINEST and NEWEST

NEW

**MAGNECORDERETTE**

A Distinctive and Professional TAPE RECORDER that is Designed for the Professional, yet PRICED for the Home!

Meeting the same high standard of all Magnecord equipment, the MAGNECORDERETTE is your assurance of professional realism in sound reproduction.

Use your present High Fidelity or Radio Amplifier and Enjoy Fine Tape Recordings played on the WORLD'S HIGHEST FIDELITY PROFESSIONAL TAPE RECORDER.

The MAGNECORDERETTE long awaited by lovers of fine music, offers beauty of appearance along with the finest in tape recording equipment. The distinctive cabinet is available in either beautiful blond or dark rich Mahogany finish. Styled to blend appealingly with any decor, the MAGNECORDERETTE is the tape recorder for your home or professional use.

**USE.** Designed to meet N.A.B. standards, the MAGNECORDERETTE contains a PT6-AH mechanical unit and a "custom"-amplifier. This "custom" amplifier provides a new Magnecord plus: ability to record and playback through your present high fidelity or radio amplifier. For "live" recording, the "custom"-amplifier provides a high impedance microphone input.

Record fine music, favorite radio shows — from your present AM-FM or TV tuner — and playback your tape library time and time again with the finest in recording realism.

**FEATURES.** The proven professional precision and quality of the PT6-AH mechanical unit.

**ON THE FRONT PANEL OF CUSTOM-AMPLIFIER:**
- Magic eye volume indicator.
- Gain control switch.
- Record/playback switch.
- Equalizer-speed selector.
- Phone jack for monitoring during both record and playback operation.

WORLD'S FINEST TAPE RECORDER FOR THE HOME

Simple to operate, beautiful to own, professional in quality ... you'll be proud of your new MAGNECORDERETTE.

In stock for immediate delivery ........................................... $385.00

**SPECIFICATIONS:**

**RECORDING SPEEDS:**
15 inches/sec., or 7½ inches/sec. Interchangeable. (No tools required.)

**REWIND SPEED:**
Full 7½ inch reel (1200 ft. of tape) rewound in approx. 40 seconds.

**FREQUENCY RESPONSE:**
At 15 inches/sec. from below 50 cps. to 15 k ± 2 db. At 7½ inches/sec.: 50 cps. to 7 k ± 2 db. when the proper equalizer for the specific speed is used in the amplifier.

**MOTORS:**
Synchronous 117 V 60 cycle AC drive motor. Shaded pole motor for rewind.

**FLUTTER:**
Max. 0.3%

**POWER REQUIREMENTS**
117 volts 60-cycle single-phase AC 70 watts.

**DIMENSIONS:**
12½"L x 20½"W x 16"D.

**PANEL:**
Magnecord grey hammered finish.

**BIAS OSCILLATOR:**
Built in. Uses single 12AU7 tube. 6.3 at .3 amps and 300 V at 40 ma supplied from amplifier.

**10½-INCH REEL ADAPTER MECHANISM**
Can be attached simply and easily to all MAGNECORD and MAGNECORDERETTE Professional Tape Recorders. Adapter extension arms fit under thumb screws securing the front panel. Simple belts drive the adaptors from pulleys which snap on to the existing reel hubs. Complete record playback, rewind and high speed forward is possible with 10½-inch reels.

In stock for immediate delivery ........................................... $35.00

HARVEY'S New Catalog of High Fidelity Equipment is NOW AVAILABLE! Write Dept. AS

VISIT THE AUDIO-TORIUM. Come in and visit our new sound department ... all these items and many more on working display at all times.

NOTE: In view of the rapidly changing market conditions, all prices shown are subject to change without notice and are Net, F.O.B., N.Y.C.

Telephone: (212) 679-1500

HARVEY RADIO COMPANY, INC.

103 West 43rd St., New York 18, N.Y.
EDWARD TATNALL CANBY*

I Fall Further into Audio

until August, 1945. These men were in the middle of things, whether U-235—or amplifiers for music. Couldn’t help picking up a thing or two from them.

Amplifier and Baffle

And so I got as fine a working background of random scientific knowledge as you could ask for. And in no time at all, a mathematical genius and avid collector of Science Fiction named The Duke (Dr. John Tukey) decided I ought to build me an amplifier. Tear up my old 16-tuber.

Phew! I did, with his very, very extensive aid and comfort. Natch, he had to teach me how it worked, too, and did I suffer. I couldn’t get anything straight and I couldn’t bore a hole in metal or solder a wire to save my neck. I felt awful dumb, surrounded by all that aggregation of brain-power, there. But I guess I absorbed a bit of radiation. My amplifier worked, even if it did look like a tin can opened with a blunt axe.

So the radio had a separate new beam-power (wow!) amplifier for its audio. New pickup, too. A fine Astatic model D, flat to almost 4000 cps and chrome plated. (But then we didn’t have any pickups in them days.) Then came a baffle. Took the speaker out of the radio and mounted it in a perfectly enormous sheet of celotex that practically filled up my room. I suppose the idea was a sort of infinite baffle, but all I can say is that aside from being a rather breathtakingly radical innovation for an old console man like me, the new baffle did wonders for that old speaker—the same old one. To be sure, I was forced, month by month, to saw off more and more of that nonstosity until it ended up as a four-foot-square nodule with hinges in the middle so I could get it in and out of the door when I moved away for the summer. But for some years thereafter, I made a practice of removing friends’ radio speakers into flat baffles, to their utter delight. And I never heard of a case where there wasn’t considerable improvement. Laugh if you will.

Best of all, somebody showed me the trick of standing your laurel in a fireplace (unmusd). What a bass that gives. A really good bass, too, since a proper chimney produces a kind of horn which, though hardly exponential, is almost infinite.

Phonocorsets

That was off-hours and meal times. In 1936, the Princeton Music department got the Carnegie set. Some thousands of records (78 r.p.m.) plus a “phonograph” that was absurdly unbelievable. An 18-inch maze of two tweeters, marked to 15,000 cps on separate controls, and a bass reflex cabinet that weighed about 800 pounds at a guess. A separate 18-in. table and 8-arm pickup, mounted in another heavyweight box. 1936! That thing could blow any roof off and it almost did when I got my hands on it. We had an AM tuner built and in the Fall of 1937 we "broadcast" the famous NBC Symphony concerts into a huge lecture hall, at perhaps 1.5 times the volume of the original orchestra. Some people, strangely enough, were not impressed, but then this was only 1937 after all. As for me, I was falling into hi-fi with quite a dizzy speed, I rolled in it.

On that fabulous machine I gave phonograph concerts. "Phonocorsets," I called them, trying to kill the highbrow sound of it all. We got almost a half dozen students interested. Chummy little parties. Music didn’t appeal, it seemed, even via an 18-in. speaker from Federal Telephonic. (I have often enough since then been furious at the blithe disinterest of those wealthy and half-educated youths. Plenty of others would have been delighted at the chance to hear the tremendous range of music we had on records then.) Anyhow, maybe our students didn’t approve, but I did, and I got to learn a great deal about making proper—and improper—use of a good machine. Tried a million tricks, including indirect lighting and even no lights at all. Sometimes helps with mood-making.

During those summers I tried outdoor concerts in a clubhouse at the edge of a moonlit Connecticut lake. That worked all right. People sat in canoes and listened across the water.

Record Library

Meanwhile, we had the happy problem of organizing our thousands of records into a lending library, and the devising of

[Continued on page 38]
In music,
listening quality
is everything

that's what the man says...

"... your ingenious AUDAX for playing all records is a great convenience, to be sure. But, it is the outstanding musical quality that finally sold me on your CHROMATIC POLYPHASE—easily the finest I have ever heard. I have just about every pickup on the market, all with high kilocycles, and know from costly experience that the NBC Symphony violinist* is right—listening quality is everything. Thank you for making this remarkable instrument possible..." (from a letter)

* See February issue.

For years, Weil has been preaching that in reproduced music, listening quality is everything, just as it is at the actual concert. If the quality is present, you may be sure the range is there also. The reverse, however, is not always the case.

Never before such EAR-QUALITY, such FAITHFUL REPRODUCTION, but... after all the reams are written about kilocycles and other laboratory data—when the chips are down—YOU and only YOU can decide what sounds best and most pleasing. Therefore... SEE and HEAR POLYPHASE and—YOU be the judge.

with the new Compass-pivoted Audax arms and for Record Changers.

Write for editorial reprint on POLYPHASE Principles

Be sure to obtain a copy of PHONO FACTS from your distributor

AUDAX COMPANY
500 Fifth Avenue New York 18

"Creator of Fine Electro-Acoustical apparatus for over 25 years."

Audio Engineering • April, 1952
**RECORD REVIEW**

**from page 36**

A cataloguing system. I haven't been in that still existing library since 1940 and I'm scared to look at the "system" I worked out was so complicated that nobody but me could ever find any records. You have to sort of look at the great file cabinet, you see a label marked W20 vOp colTrs. You'd know of course that it read "Wagner: vocal opera bit Tristia." Simple. The system almost collapsed when I started putting in duplicates for the back sides of records, with cross-references. You had to read your labels twice.

**High Fidelity? Our rule sheet specified—at my insistence—that only cotta or fibre records be played.** Well, we. We. We had to put labels on half the tracks of the great records, and we didn't manage to get any information. Full 50-cent Buick was cut down by our old record labels, and even the Carnegie plottograph too. You could run it with only one cartridge, ignoring the zillions of tweeters which never did get to produce anything, from our pickup and AM tuner, over 7500.00.00.

Also, the Engineering Department discovered our record library and immediately decided that the Professor needed a "better" and more versatile system for his personal lectures, with records. He was game (not knowing engineers as some of us do) and so they barged ahead with glee. Couple of months later.

A delegation arrived with what must have been the Original Hi-fi system itself. It was a big suitcase thing, a playtable (with the usual Astantic straight-arm pickup) and—pride and joy—a super-control console with Everything. Don't remember the details, but I've got it tucked away.

Came the lecture, 25 students. The professor had been coached by all hands, simultaneously of course, and he was somewhat shaken. This stuff was all new to him. The students had, of course, forgotten to put labels on half of the knobs, and others had cryptic words like gain meaning nothing whatsoever to a good musician. All was not yet first. No, just talk and quite inspired, too; the machine was for the moment forgotten.

Finally, the professor, already notated. Professor turned quickly to his new gadget. Instantly a horrid blat came forth. (Yep, a loss grouch rather than a bit of clarity.) The needle jumped like a deer and an engineer rushed up and stopped the noise immediately but the loss was already as white as a sheet. Bravely, he approached the record again—he was after a theme along about dead center of the grooves. Alas, someone had left the volume on full (at 95) and a label had already forgotten which knob to try. The needle touched the record with a scrape, the professor's hand jumped, and the pickup squealed all its 5 ounces straight across. Finally the record was properly placed, and the first ten rows of audience into the concrete floor. But Professor was now desperate—the tape was going. So he grabbed the arm and went after that theme, with a vengeance. It had to be somewhere on the record, in the every-where—gain still being at the top. . . .

The "system" was removed forever, the next day. And that, children, was how I learned that sometimes it's a bit hard to reconcile the viewpoints of engineers and musicians as to what is a good machine! I've been don't my little bit to help, ever since.

**Key**

- Excellent sound and cuteness.
- Deadness, deadhead.
- Poor. Bad Big bass.
- Some distortion in highs. Flat top.
- Needs boost over normal LP playback.
- Some, rather distant pickup. From older 78 rpm. (Needs closely spaced.)
- Some surface noise. Will need boost over normal LP playback.

**Alphabet Soup and Hi-Fi**

London started it even before LP, with the famous "firs"—it was Decca firs then. Now, the alphabet idea is spreading, along with other terms indicating quality of sound.

For a special sort, Remington now uses CARR, "Complete Audible-Range Engineering." Westminster, though more expensive, uses "Natural Balance," (a phrase just possibly borrowed from this writer's constant use of it these decades). American Decca's "Gold Label" pushes another angle, the relatively old one of general musical excellence—Gold Label Decca includes both new and older recordings (thereby generating confusion with RCA's gold label, reserved for reissues of technically under-par material of value). Mercury, with the "Olympian" series, makes its bid for over-all excellence in all phases; now, Capitol has joined in the valour with FDS, "Full Dimensional Sound.

The urge behind all of this is clearly a growing public awareness of over-all quality, a larger scope than the old "hi-fi" in the past. Mercury's "Olympian" technique, and they rate very high, too. Somewhat different effect here—the simple (Telefunken) wire gives exceptionally clean sound, but the liveness is a bit off for the Bartok and Bloch recording; a slightly narrow sound, not quite as broad and full as sense. The "Olympian," however, is tremendous. I would give this one a decisive edge in performance; it is sharper, brassier orchestration of Ravel—this one is like the world's masterpieces of instrumentation. The "Full Dimensional Sound," the other, is the high highlight of the present group. And the "Gold Label" is as I have never heard the piece before; dramatic, tense, sure. Mercury jumps into a trilling loop way back to the very foci.
HARRISON AUDIO SHOP features...

NEW! Grommes PROFESSIONAL PRE-AMPLIFIER

A deluxe completely variable equalizer pre-amplifier of the feedback type with quality that exceeds broadcast standards! It will equalize the high and low end recording characteristics of any phonograph record, it features extremely wide range and low distortion, high gain and high signal to noise ratio. Output is cathode follower type enabling the basic amplifier to be located any distance away.

- Frequency response 5 db. 6 to 100,000 cps. (+ -1 db. 10 to 50,000 cps.) through radio or microphone channel.
- Distortion—less than .05% harmonic and 1% intermodulation.
- Controls—
  1. Selector switch for radio, phon 78, phon 12, and 15 db. (N.A.B.)
  2. Bass frequency for 800, 100, and 300 cps.
  3. Treble roll off at 10,000 cps. -4, -12, and 15 db. (N.A.B.)
  4. Automatic loudness control with cut out switch.

- 5. Bass switch calibrated from -22 db. to -15 db. (10 db.)
- 6. Treble switch calibrated from -18 db. to -15 db. (10,000 cps.)
- Magnetic pickup preamp-feedback equalization down to 20 db. 20 db. maxi-
  mum). 47,000 input, separate level control.
- Hum and Noise—Radio channel to 80 db. below maximum output.
- Tubes—3 - 6557 and 6V7GT
- Power requirements 300 V.D.C. -9MA and 6.3V-1.7A
- Size—14" x 5/6" x 6".

$99.50

Ideal for use with Acro Ultra-Linear, Williamson, or any high quality power amplifier.

DON'T WEAR OUT YOUR RECORDS!

Use the New WEATHERS FM PICKUP

- 20 to 20,000 cycle flat response—realism without noise!
- Only one gram pressure!

The world's lightest-pressure phone pickup! New principle—instead of the record and needle working to generate an audio voltage, the Weathers Pickup merely frequency modulates an external oscillator (the difference between pumping water, or turning on a faucet!) The result is almost unbelievable realism of reproduction with practically no groove wear. Your records retain their brilliancy indefinitely! Universal mounting car-

$37.50

tridge fits domestic player and changer arms. Oscillator output is "Constant Amplitude" or "AES Compensated" to match any amplifier input. Requires 6.3 volts ac at .3 amps and 250 volts dc at 2 ma. (from amplifier, or from Weathers power supply—$14.50). Descriptive literature available.

Complete cartridge, with sapphire tip style, and oscillator. Order now, for fast delivery.

Special Purchase!

MEISSNER 8C FM TUNER

Frequency range—88 to 108-

- Audio fidelity—flat within 2 db. from 50 to 15,000 cps.
- May be used with any audio amplifier with high imped-
  ance input.
- Complete in light walnut fin-
  ish cabinet.
  Regularly $53.60

NOW ONLY $44.00

Another Harrison First!

WHARFEDALE SUPER 5" Tweeter

- Frequency response 3,000 to 20,000 cy-
  cles!

A highly efficient tweeter speaker with baffleless cone for wide diffusion. High-fine density 132-

-1000 (1) magnet for wide re-

-10 ohm aluminum voice coil suitable for use with a 15 ohm bass unit. Recommended crossover is 2,000 cps. Handles 10 watts without distortion. Mounted on 8" x 8" plywood baffle.

It's New... $20.95

Hear your Ultra Linear (or any amplifier) at its best with a WHARFEDALE SPEAKER

Smooth 20 to 18,000 cycle re-

-10 db. 20 db. power rating. 10.3/11.015 ohm VC. Exclusive cloth suspended cone minimizes transient distor-

-13" x 3/4"

Limited Quantity! You’ll recognize the top quality make.

If C. O. D. is desired, please enclose 25% Deposit

ARRISON RADIO CORPORATION

227 GREENWICH ST.
NEW YORK 7, N. Y. • Bar&y 7-7777

AudiO ENGINEERING • APRIL, 1952
From "flyweight" High Q Chokes to "heavyweight" Modulation bruisers, CHICAGO "Sealed-in-Steel" transformers are really rugged. Talk about "torture"—these units can "take it," and deliver complete dependability and continuous service under the most adverse conditions. Your electronic parts distributor can supply the complete range of CHICAGO New Equipment units for every modern circuit requirement: Power, Bias, Filament, Filter, Audio, MIL-T-27, Stepdown, etc.—all in exclusive "Sealed-in-Steel" construction.


Concert Hall's two Ravel items make a good pair: the quartet, ultra-French in its colportous, impressionistic atmosphere, is well played by an older French team, though my favorite version is the other, the Philadelphia LP along with Debussy's quartet. If you choose Concert Hall, the Ravel Sonata, violin and cello—alone without piano—is an extraordinarily modern late work (1922), with astonishing harmonic and instrumental color—hard to believe that these two alone could produce such varied sounds. Top playing, the recording OK. (Re-issue of earlier "limited" ed. 781.)

Debussy, Cello Sonata. Franck, Cello Sonata in A. Marcel Hubert, Harold Dart. Allegro AL 110

The only LP recording of the first of Debussy's three late sonatas—utterly unlike the late Ravel work (and neither is at all like the familiar impressionist work of both younger men). This is a curiously fragmentary, episodic piece, growing on you as you adjust to its strange pace. The Franck is the familiar violin sonata—"said to have been written originally" for cello. It makes fine cello music but this is a rather pale-colored playing.

Debussy, Six Epigraphes Antiques; Petite Suite; Piano Four Hands. Caroline Nord- wood, Eleanor Hancock, pianists. Lyriciphil L 21

A late work and a familiar early work in the same medium, the always interesting, seldom-seen four-hand piano team, two people at one piano. These young pianists play the simple suite melodiously, now a familiar sort of music; with excellent feeling, a quiet, non-percussive touch. The late Epigraphes are tough, not miliee the cello sonata (above); here there is more trouble establishing the mood, more awareness of piano and finger mechanisms. Very fine piano recording, steady as a rock and ultra-natural.

Debussy, Twelve Etudes for piano. Charles Rosen. R.E.B. #4

This is a major LP offering in the piano field. Debussy's last big piano set, like other series of etudes nominally study material, actually brilliant pieces each "taking off" from some technical problem—thirds, fourths, repeated notes, compound arpeggios, etc. These are masterfully played by a gifted and knowledgeable pianist (also instructor in Romance Languages at Princeton), who writes most interesting notes for his own playing. Tough stuff, again, but makes up for it in brilliancy of sound. Fine recording, the bass very big (mike under piano perhaps?).

Debussy, Péllicas et Méliandre. Irène Joachim, Jacques Jansen, Etchevery, etc. Orchestra, cond. Roger Desormières. RCA LCT 6103 (3)

RCA's Gold Label Treasury series is touching forward to include—quite honestly—recordings such as this that are only a few years old, yet already technically out of date. (In spite of its advantage in good older recordings, Columbia will sooner or later have to adopt some similar measure for its undoubtedly 78 treasures.)

This all-French performance of the great Debussy opera is a stunning job; the strange, other-worldly character of this unique opera is ideal for records, the singers are those perfect French voices we can so easily envy, the whole production is unified musically and dramatically in rare fashion. Recording is "adequate"—i.e., done via disc with a $5000 e.s.p. top (just enough to get a trace of a sound) in a French anechoic chamber—or at least a studio draped with layers of velvet and foam rubber! Can't spoil the music for those who like it.

Song Cycles—Fauré, Les Mélodies de Venise; Debussy, Ariettes Oubliées. (Ver-
Vanguard VRS 414

The interest here centers about the parallel settings of the same poems of Verlaine by each of these composers; also the fact that—for once—a tenor who sings, not the usual wobbling and enthusiastic soprano! Cuenod, Swiss, has the somewhat nasal voice required for good French singing; plus excellent musicianship. Blanzard, also Swiss, lacks the Gallic piano-feel that is best for this music but her accompaniment is more than competent. A good LP for singers to study.

Moderno—dissonantly hi-fi

* Martinu, Concerto for String Quartet and Orch. Vienna Konzerhaus Quartet, Vienna State Opera Orch., Swoboda.
* Martinu, Serenade; Partita (Suite #1) for Orch. Winterthur Symphony, Swoboda.
* Westminster WL 5079
* Martinu, Sonata, Sonatina for Two Violins and Piano. Willy and Margarete Schweda; Jan Behr.

Urana URLP 5004 (10"

Martini's dissonance is slick, fluent, Bach-tary, not hard to take, thanks to strong rhythm, lack of heaviness. Freshly in its way.

* Westminster WL 5091
* Columbia ML 2203
* North, Music from "Streetcar Named Desire." (From the film sound track.)
* Capitol L 289 (10"
* Bartok, Two Rhapsodies for Violin and Orch. (1928). Emanuel Vardi; New Symphony, Autori, Serly.

Bartok BRS 306 (10"

All the above share the anxious, dissonant, often humorously-horrific feeling of the 20's and early 30's—to varying extents depending on the composer: except the "Streetcar" music which is a kind of reflection in popular terms of the earlier era. All are stunningly good recordings.

* Bloch, Scholomo (cello and orch.). (With Saint-Saëns Cello Concerto.) Leonard Rose; N. Y. Philharmonic, Mitropoulos.
* Columbia ML 4425 (10"
* RCA Victor LM 112 (1/2)
* Hartmann, Symphony # 4 for Strings, INR Symphony, André.

capitol L-8146

Hindemith, Symphonic Dances (1928). RIAS Symphony, Fricsay.

Decca DL 7520 10"

* Schuman, Symphony III. Phila. Orch., Ormandy.
* Columbia ML 4413
* Respighi, Trittico Botticelliano (Botticelli Tryptich). Vienna State Opera Orch., Litschauer. (With Locatelli, Conc. da Camera.)
* Vanguard VRS 418 (1/2)
* Bartok, Violin Concerto (1938). Tibor Varga; Berlin Philharmonic, Fricsay.
* Variations of Decca DL 9545

* Bartok, Viola Concerto (completed by Serly). Wm. Primrose; New Symphony, Serly.

Bartok BRS 309

The above group shares, to greater or lesser degree, aspects of earlier Romantic music; a serious, non-nausea, approach, a big orchestra, colored in the older manner, sometimes a pictorial "tone painting"—as in Bloch and Respighi, plenty of expressive solo melody, non-kiddish style. Good for you, if you prefer a less "popular" sound.

The Turner TV Booster

Low-noise-level Cascade circuit produces a good picture under receiving conditions that nullify the efforts of many other leading boosters.

* The Turner TV Booster

The Model 33

The most popular general purpose microphone on the market. Accurate pick-up and faithful reproduction with either the 33X Crystal or 33D Dynamic.

Model 211D Model 60X Model 87 Velocity Model 99D-999D-U9S

Model 77 Cardiod Model 22X-22D Model 34X Model 25X-25D

Model 9X-9D

See the sparkling NEW additions to the famous Turner line at the 1952 Radio Parts Show, May 19-23, Hilton Hotel, Chicago.

**The Turner Company**

**IN CANADA:**

Canadian Marconi Co., Ltd.

Toronto, Ont., and Branches

89 Broadway Street, New York 4

Crystals licensed under patents of the Brush Development Company.
NEW PRODUCTS

- **Home-Model Magne recorder,** Music lovers and audio hobbists alike will find distinct information in the Magne-Cordette, a new tape recorder for use in their high-quality music systems. Designed to meet B.B. audio standards, the new unit is composed of a professional Type FTA-121 tape transport mechanism and a newly-developed amplifier, both housed in a heavy-duty aluminum case. High-impedance input has sufficient gain for either microphone or tuner. Output level is designed for feeding into low-gain input of any high-quality amplifier. Recording speeds are 15 or 7½ in./sec. and can be converted without attenuation. Rewind speed permits rewind of full 7½ in. tape in 10 seconds. Frequency response is 15 in./sec. extends below 25 cps and beyond 15,000 cps ± 2 db. Maximum flutter is 0.3 percent. Amplifier panel controls include magic-eye volume indicator, gain, record-playback switch, and equalizer-speed selector. Headphone jack permits monitoring. Priced moderately, the Magne-Cordette brings professional audio performance to the average living room. MagneRecord, Inc., 369 N. Michigan Ave., Chicago 1, Ill.

- **Tape Storage Chest.** An innovation in the merchandising of magnetic tape is the new "Tape-Chest," a 5-drawer filing system given free to consumers upon purchase of 5 rolls of Reeves Soundcraft tape. Each drawer, for a single roll of tape, has a polished brass knob and a label for identifying program material.

The unit is made of durable linseed board and is attractively finished in royal blue. Available in two sizes, to accommodate 625 or 1320-ft. rolls. Undoubtedly, the Tape Chest will accomplish the objectives so longed for by Reeves in introducing it—to stimulate the hobby of building tape libraries of memorable events, sound effects, and fine art. Reeves Soundcraft Corp., 10 E. 52nd St., New York City, N. Y.

- **Portable Tape Recorder.** Designed for use with high-quality home music systems, the new tapeMaster Model PT-121 is built to BTMA standards. It consists of a tapeMaster transport mechanism and matching self-power-preamplifier with push-pull ultrasonic bias-erase oscillator. Four wired preamplifier channel and playback system at low cost. Operation is at standard speed of 7½ in./sec. Dual-track, head. Fast-forward and rewind ratio is twenty to one. High-impedance inputs for both radio tuner and microphone. Frequency is 76 to 8000 cps ± 3 db. Signal-to-noise ratio is 74 db. Non-stereo type is indicator. The PF-121 is supplied in a sturdy, portable case covered with water-resistant leatherette. Overall dimensions are 12½ × 15½ × 9½ in. Weight complete with two reels is 21½ lbs. Further information is given in Bulletin No. 161. For free copy write to the manufacturer, tapeMaster Inc., 13 W. Hubbard St., Chicago 10, Ill.

- **Photo-Top Mobile Amplifier.** Carnivals, sound trucks, resorts, and the like, will benefit many stages for the new Newcomb Model E-25MP mobile amplifier. The unit provides 25 watts audio output and uses either 6-volt d.c. or 115-volt a.c. power supply. Has two microphone inputs in addition to phono. Equipped with standby switch which conserves battery, at the same time keeping tubes warm. Separate and amplifier-power switches. Heavy-duty switches provide dependable power connections. Cabinet is finished in two-tone gray enamel. Control panel is etched metal. The E-25MP is ruggedly built to stand rougher-than-normal usage. Available also as Model E-25M without phone top. Manufactured by Newcomb Audio Products Co., 6824 Lofrington Ave., Hollywood 25, Calif.

- **Audio Control Console.** Many features usually found only in custom-built equipment are inherent in the new RCA Type BCS-13A magnetic consolette, which provides complete control of as many as ten program sources feeding into three outgoing lines. Equipped with stepping relays, the consolette permits preset program source selection for all outgoing channels. Bridging-type input affords operation from any line of 600 ohms or lower. Separate master gain control and V.U. meter is supplied for each channel. Failure of power supply to relay circuits does not cause program interruption, nor does restoration of power require resetting. Top panel is removable and front panel is hinged for easy access to all components. Receiving Division of Radio Corporation of America, Camden, N. J.

- **Toroidal Output Transformer.** Excellent frequency response, low distortion, high-power-handling. Excellent frequency of impedance ratios are combined in the General ludio-Transformer. Excellent frequency response. In addition to its use in regular audio amplifiers, it is well suited for use in high-power-handling amplifiers for electronic musical instruments, and in constant voltage output transformer systems. Eighteen impedance ratios can be obtained covering a wide range of values. Primary windings can be separated as required in certain single-ended push-pull amplifier circuits. Although weighing only 7 lbs. and measuring but 3½ in. high by 7½ in. diameter, the 250A has a continuous power rating of 50 watts. Distortion is less than 1% at 50 watts. Upper frequency limit is 100 kc. General Radio Company, 275 Massachusetts Ave., Cambridge 39, Mass.

- **Turnover Cartridge.** Two complete cartridge assemblies mounted back-to-back on a single plate, make up the new Astatic Black Mag. manufactured by Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood 25, Calif. Particularly useful where two needles are used to drive a single motor, is thus avoided.

- **Anti-Static Compound.** Eliminating the effects of static on plastic sheets, molded parts, or phonograph records, the Compound No. 79 produced by Merix Chemical Co., 1021 E. 55th St., Chicago 15, Ill., is again available. Particularly valuable for either records or plastic meter cases, this product prevents collection of dust—particularly useful on the former—and avoids erroneous indications of the latter due to rubbing of the case. Merix Anti-Static Compound Number 79 is applied by dip, spray, or brush, and is required on only one side of any plastic up to 1/8 inch thick.

- **Wireless Microphone.** Complete mobile for TV, motion picture, and stage performances is afforded by the new Stephens Radio Link, a tiny transmitter which, complete with microphone, can be concealed in the clothing of the user. When turned on, the transmitter emits a wave which is picked up by a receiver located near a convenient microphone outlet. Outfit of the receiver is at microphone level, consequently it can be fed into a mixer at the amplifier input, at the same time distorting or noise. In fact, the new unit is approximately 125 feet. Audio frequency range is 36 to 16,000 cps, thus allowing the unit for pick-ups of even the most demanding nature. No longer a task of a pack of cigarettes, with battery case to match, the Radio Link has been used in a number of motion pictures and TV programs to record sound.
Leonard High Fidelity Sound Equipment at Its Finest

The Famous "Leonard Leader"

This COMPLETE, Ready-to-Install High Fidelity Radio-Phone System with the Finest Names in Audio Equipment.

**MEISSNER TUNER—Model BCC**

(FM only)

- Gives amazingly clear reception.
- All of the above for our special price, only $130.78
- The "Leonard Leader" is as above, but with MEISSNER TUNER, Model BBT (AM-FM) at $146.25
- Ask about our other "Packaged Specials."

**NEW GROMMES "LITTLE JEWEL" AMPLIFIER**

Has built-in preamp, dual tone controls, 3 inputs. Frequency response ± 1 db. 40 to 15,000 cps. Max. Input: 15 watts above 30 cps, 20 watts above 100 cps.

**ELECTRO-VOICE SPEAKER—Model SP128**

12" coaxial extended range speaker. Frequency response 75 to 15,000 cps ± 6 db. Max. Input, 15 watts above 30 cps, 20 watts above 100 cps.

**VM RECORD CHANGER**

This latest improved Model 950 GE incorporates a 16 speed, fully automatic, high fidelity, variable reluctance triple-needle stylus, with carrying case. All $435.00.

**CONCERTONE TAPE RECORDER**

Brings you "Living Sound" A precision-built, thoroughly tested instrument. Has every feature of the most expensive professional equipment. Available with NAB standards. Simultaneous monitoring from the tape while recording. Separate heads for high frequency erase, record and playback. Recoding speed 7.5" per second. Plays standard 5", 7" and NAB 10" reels. High speed rewind-fast-forward and reverse 2,500 ft. in 3 minutes. All controls interlocked to prevent spilling or tearing tape. Frequency response 5 kHz, from 50 to 15,000 cps at 15" per second. ± 2 db from 50 to 9,000 cps at 7.5" per second. Total harmonic distortion, less than 2% at normal maximum signal level. Basic Recorder (with either single or dual track heads).

- Available with carrying case and monitoring Amplifier, Speaker...
- Model 501—Net $92.50
- Available with carrying case only...
- Model 502—Net $87.30

**NEW UNIVERSITY DIFFUSIONE 12" SPEAKER**


**STEPSHENS 112FR SPEAKER—12" Co-Spiral Full Range**

13/4 lb. Alnico V permanent magnet, 8 to 16 ohms. 5/16" deep, 12/4" diameter. Over 50 hz frequency dispersion. Net $30.87

Make your own CABINET

1 for 12" Speaker, 1 for 15" Speaker

Assemble your own folded horn from a CABINET kit. All materials included.

- Gain a full octave of clean bass never reproduced by ordinary cabinets.
- Model 61—12" Speaker........... Net $19.95
- Model 63—15" Speaker........... Net $23.95

Mail Orders filled promptly. Write Dept. A4 for immediate, courteous service.

Send now for our FREE 48 p. CATALOG of the latest and finest in Sound Equipment.
This can be put after $S_p$ in the grid circuit of each channel. This will allow free mixing of the input channels, and still give independent control of output level. When feeding a P.A. from one channel, this would help to prevent feedback while maintaining level on the broadcast circuit. In the power supply, the circuit shown in Fig. 1 is the one included in a second model of this amplifier that was built. Although the original operated well, it was felt that it did not have the gain necessary for all applications. The first model has a transformerless supply for the plate voltage, and uses a single-section selenium rectifier. The output from this arrangement is only about 120 volts, and did not provide the power necessary for long-line operation. A small transformer was mounted under the chassis for the filament supply and no hum was encountered with this arrangement. In the second model, the power transformer introduced some hum, but it was reduced to almost zero by putting it in its own shield can and mounting it at the side of the chassis next to the output transformers.

In the original model, the intent was to keep the size down to a minimum. Two 12AX7's were used in the first two stages, and a 12AU7 in the output. The gain of this unit was only about 50 db, and the output was quite low, but in its original use, the lines were quiet and short, so no trouble was encountered. This might be sufficient if the unit were to be used in a small town. The chassis was 3 in. wide, 12 in. long and 2 in. deep, and was mounted in a 3½ x 6 x 12 cabinet with a hinged top. The leads to the two gain controls were brought out from the chassis in shielded leads, and mounted on the front of the cabinet. It is desirable to keep the controls close to the paralleling switch $S$, to prevent stray pickup. The original model did not need any extra shielding around $S_p$, but it would not do any harm to include it, lest one get caught with a pickup in a location with high electrical noise.

While this unit is admittedly designed primarily for a specific application, so much use has been made of it that it was felt that other stations may have had similar problems. It is presented therefore, not with the intention of establishing a policy of operation for a station, but merely as a suggestion as to the possibilities of deviating from standard practice to accomplish a specific problem.

Parts List

- $C_1, C_5$: 1.0 μf, paper
- $C_2, C_6, C_7, C_8$: .01 μf, mica
- $C_9, C_{10}$: 100 μf, 15 v. electrolytic
- $C_{11}, C_{12}$: 40 μf, 450 v. electrolytic
- $C_{13}, C_{14}$: 20 μf, 350 v. electrolytic
- $C_{15}, C_{16}$: 10 μf, 350 v. electrolytic
- $L_1$: 8 H, 50-ma, a.c./d.c. choke
- $R_1, R_{12}, R_{14}, R_{16}$: 0.07 meg, 1/2 watt
- $R_2$: 180 ohms, 1/2 watt
- $R_{13}$: 0.1 meg, 1/2 watt
- $R_5, R_7$: 0.5-meg potentiometer, audio taper
- $R_{10}, R_{11}$: 15,000 ohms, 1/2 watt
- $R_{14}$: 300 ohms, 1/2 watt
- $R_{15}$: 350 ohms, 1 watt
- $R_{16}$: 2200 ohms, 1 watt
- $R_8$: 51 ohms, 1/2 watt
- $S_1$: SPST toggle switch
- $S_2$: 4PDT and DPDT locking-type telephone key
- $T_6, T_8$: Microphone to grid, miniature type input transformer
- $T_7, T_9$: Plate to line, miniature type output transformer, 20,000 ohms to 600/150
- $T_9$: 350-0-350 v. at 50 ma; 6.3 v. at 2 amps.
using your tuner

[from page 29]

the radio volume control at one setting. Tone controls will probably not work but it is far better to use those on the amplifier if any.

If the radio includes a phonograph it may be left as is but if a magnetic cartridge is to be added, the plug at the end of the cable coming from the pickup must be removed from the socket on the chassis. The plug can be cut off and another piece of shielded cable may be spliced to the pickup lead—bare wire to bare wire and shield to shield—and led to the amplifier. The distance between radio-phonograph and amplifier should be as short as possible to avoid a loss of highs.

The technique of obtaining audio output is useful not only with radio receivers but also with tuners which have audio amplification stages. The audio stages in most tuners are not as good as those in most separate amplifiers, in addition to which it is usually best to bypass the built-in tone controls, especially on FM tuners.

TV Set Connections

Television receivers present a somewhat tougher problem because few owners like to remove the chassis from the cabinet for fear of damaging the cathode-ray tube. The solution with most TV sets is to remove the power-amplifier tube (usually the receivers do not have push-pull outputs) and substitute an octal plug, obtainable at the parts dealer.

Output tubes are fairly easily identified even without a circuit diagram. Common ones are: 6J6, and 6K6, which are full-size, octal (8-pin) tubes. Most TV receivers are not transformerless so removing the audio output tube does no harm, and an isolation transformer is not needed. Again prepare the shielded cable leading to the amplifier and solder the outer conductor to pin 5 of the octal plug. Pin 5 is indicated in Fig. 3, a view of the plug looking at the prongs. Connect a wire from the cable shield to a point obviously touching the chassis; often the end can be terminated under a screw head.

The method of connecting to the amplifier varies with the amplifier. Figure 4 shows the Bogen DB10 amplifier, which has provision for radio or TV connections. Fig. 4. Bogen DB-10 amplifier, typical of the smaller units used in unit-type systems.

MAGNECORDER

high fidelity

tape recorder

Yes, experienced radio engineers choose MAGNECORDER above all other professional tape recorders.

There are many reasons.

In Magnecorder you get—

Perfect sound recording under almost any conditions

Low distortion and lifelike tone quality

Unit combinations for portable, rack or console use

More operational features to meet the most exacting needs

Precision construction for precision performance

Frequency response flat from 10 to 15,000 cps ± 2 db.

True high fidelity!

Arrange for a sound demonstration at your local Magnecorder distributor's today!

Magnecorder, Inc. Professional Tape Recorders

360 N. Michigan Avenue, Dept. AE-4

Chicago 1, Illinois

Please send me further information, prices, and technical data.

Name

Address

City

Zone

State

Audio Engineering • April, 1952

45
tuner input and phonograph input, though not both at the same time. A simple switch must be provided if both phonograph and radio are to be used. The method of connection is illustrated in Fig. 5. Any single-pole double-throw switch is suitable—even an ordinary toggle switch. The arm of the switch is connected through a shielded cable to a plug which fits into the jack marked AMPLIFIER INPUT. One point of the switch is connected in the same way to the jack marked PREAMP OUTPUT. The other point is connected to the end of the cable coming from the radio or TV receiver. The phonograph, if it includes a magnetic-type cartridge, is connected to one of the two magnetic phonograph jacks on the amplifier. Try the one labeled HIGH OUTPUT MAGNETIC first. If there is not enough volume change to the one titled LOW OUTPUT MAGNETIC, be sure to connect all shields together and the shield of each cable to the outer shell of its plug.

The Bell Model 2145 amplifier pictured in Fig. 6 has its own switching system in the small control unit. The left control selects either phonograph or radio, with five degrees of equalization for phonograph records or two for the radio input. The connection requires only that the plug which has been placed on the end of the cable coming from the receiver be placed in one of the jacks marked RADIO. If the radio output has been taken directly from the volume control, plug into the LO RADIO jack. If the last tube has been removed and a plug substituted in the set as described above for TV, use the hi radio jack.

Turning the selector switch on the Bell control unit to FM connects the amplifier to the radio input jacks and the signal goes straight through without change. When the switch is turned to the AM position, the treble response is reduced somewhat to remove some of the noise and distortion common in AM broadcasting.

Other amplifiers have similar arrangements and the connection method is usually well described in the instruction leaflet which comes with the amplifier.

**Westrex Announces**

- 35MM FULL WIDTH COATED
- 35MM PROFESSIONAL MAGNA-STRIPES®
- 16MM FULL WIDTH COATED (Single Perforated)
- 16MM FULL WIDTH COATED (Double Perforated)
- 17½MM FULL WIDTH COATED
- 16MM MAGNA-STRIPES®

**Westrex Magnetic Film and Tape Now Distributed by Westrex**

- ECONOMY of low first cost and long life.
- CONSTANT OUTPUT assured by electronically controlled biasing.
- GREATER DYNAMIC RANGE because of highly uniform oxide dispersion.
- HIGH FREQUENCY RESPONSE conforms to industry standards.
- POLISHED SURFACE reduces mechanical squeal.
- HIGH OUTPUT because oxide dispersion is engineered for maximum sensitivity.
- LONG HEAD LIFE results from coating oxide particles with low-friction material.
- LONG STORAGE LIFE assured by use of new triacetate safety film base.
- OXIDE FLAKING or jabbing off greatly reduced due to higher adherence of magnetic coating.
- MECHANICAL UNIFORMITY achieved by a special coating formula that minimizes curling.
- 35MM FILM EDGE NUMBERED every foot in opposite directions as an aid in editing.
- CUSTOMERS CLAIMED CLEAR BASE ACETATE FILM can be stripped with a magnetic coating—an added economy measure.
- DEVELOPED OR UNDEVELOPED PHOTOGRAPHIC FILM can also be coated for television productions or other similar usages.

Westrex now distributes Reeves Soundcraft full-coated magnetic recording film, "Magni-Stripes™", and magnetic tape in line with its policy of providing studios with the finest recording equipment and accessories.

*Trademark of Reeves Soundcraft

Research, Distribution and Service for the Motion Picture Industry

**COMING TO THE FAIR!**

**The AUDIO FAIR in Chicago**

at The Conrad Hilton Hotel, Chicago, May 23rd and May 24th, opening at 10:00 a.m. Friday, May 23rd, closing 9:00 p.m. Saturday, May 24th.

See you then . . .
LOW FREQUENCY REPRODUCTION
(from page 21)

Is there a "SECOND CONDUCTOR" in your radio-phonograph?

BANISH HIM WITH A

WORLD'S FINEST AMPLIFIER

ONLY A MCINTOSH — unique among all amplifiers—gives you music that is an exact reproduction of the original.

ONLY A MCINTOSH can reproduce your musical library with less than 1% harmonic or intermodulation distortion over the entire audible spectrum, even at peak power.

COMPARE MCINTOSH with any amplifier at any price. Write today for booklet and name of nearest dealer.

MCINTOSH LABORATORY, INC. 321 Water St., Binghamton, N. Y.

DC to AC Converters Dynamotors Genemotors

DEPENDABLE...COMPACT...EFFICIENT

Carter Rotary Power

Carter DC to AC Converters, Dynamotors, Genemotors, Magmotors, and Inductor Alternators (inverters) are made in a wide variety of types and capacities adaptable to communications, laboratory, and industrial applications, of many kinds. Widely used in aircraft, marine, and mobile radio, geophysical instruments, laboratory work, ignition, timing and many other uses.

Carter Motor Co.

2645 N. Maplewood Ave., Chicago 47
Sales Offices in Principal Cities

MAIL COUPON FOR CATALOGS

Please send catalog containing complete information on Carter Rotary Power Supplies.

Name ____________________________ Address ____________________________

*Trade Mark Registered

City ____________________________ State ____________________________

Is there a "SECOND CONDUCTOR" in your radio-phonograph?

the stiffness of the suspension system is operating close to its elastic limits. The suspension is the source of much low-frequency distortion.

One method of increasing the output at very low frequencies is to increase the radiation resistance, $R_s$, by increasing the diameter of the cone. $R_s$ increases as the square of the cone area and raises the weight of the cone. The effect is in the right direction since the mass is increased, and resonance lowered. But in order to carry this additional weight and permit movement over a long period of use, the compliant rim is made stiffer, or stronger, thus increasing $Z_m$ and offsetting to some degree the full benefit of the larger diameter. Thus performance does not confirm the theoretical improvement attainable with the increase in diaphragm area.

At this point the designer attempts to lower the stiffness of the rim; that is, to make it more compliant. This would be a simple and excellent aid to low-frequency improvement if it were possible to disregard high power, long life, and good transient performance. Therefore, the best that can be attained is a compromise at the point where no further distortion can possibly be tolerated at the rated maximum input power. The proud owner of the most expensive speaker system would be staggered at the amount of harmonic and inharmonic distortion in his speaker at, say 40 cps, a full octave above the low limit of our ideal speaker.

With a large cone and a compromise suspension, a lower resonant frequency is reached resulting in a larger displacement for a given input signal. Here is the antagonism between the displacement and the restoring force. At moderate excursions there is insufficient reaction or stored energy in the suspension to drive the cone back to rest quickly at the termination of the signal. This becomes a source of distortion. Under extreme excursion, the displacement close to the elastic limits of the suspension is small for a given signal increment. However, the displacement is great in the relaxed direction for the same signal as a decrement, because of the release of the stored rim energy in this extreme position. This develops enormous harmonic distortion, and the dubious satisfaction of preserving some power handling ability and reasonably long life.

Suppose there had been no compromise with the suspension, and this permitted extremely free movement to wide limits by making the rim corrugations
NEW PORTABLE

MULTI-SPEED
PENTRON
TAPE RECORDER

preferred by leading stations for on-the-spot recording

Name on request

Write for Bulletin DS51

THE PENTRON CORPORATION

Order Your 1951 Bound Volume
SUPPLY LIMITED
$8.95

AUDIO ENGINEERING
342 Madison Ave.
New York 17, N. Y.

NEGLIGENCE loading with New BRIDGER
In bridging measuring instruments across high-Z circuits, lowest possible circuit loading is vital. Improvements in Model 165's cathode follower circuit & special double-shielded cable reduce input capacity to only 3 mF. Input Z: 70 ohms, 3 mF, with 3 ft. cable. Output Z: 200 ohms. Output/input voltage ratio: 0.99. Unable to several hundred k. Price $96.50.

Do you have the data on our new GALVOMETER-PROTECTOR? Write NOW for Catalog A.

INTERMODULATION METER -
Highest Professional Flexibility at Reasonable Cost.
Model 165 1M Meter is especially suited for laboratories, broadcasters, recording studios. Signal generator, analyzer, voltmeter in single case. Reads 0.1 db, amplifier output directly on meter. Provides for use of scope to analyze & cure IM causes: full graphic instructions supplied. Wide range of low & high test frequencies: 60 cps internally, 40-2000000 externally; standard 2, 7, 12 kc internally, 20-2000000 externally. Voltage ratio choices: for LF testing, 4:1; for more accurate HF testing, 1:1. 8% x 19" rack-type panel; 12" deep. Price $250.00.

Model 97-3C $179.50
With Full Width Heads $189.50

USES FULL WIDTH HEADS

(Model 1951 Edition) Only Pentron offers this professional feature at this price! Meets exciting high-speed demands of broadcasters and sound studios. Range: 10 to 1000000 cps at 3%, 1 hour. 50 to 5000000 cps at 3% 12 hours. Interchangeable Heads—Single or dual track. Push Button Control for speed change. Portetis Speeds—Rewind forward 20 to 1. Amplifier—Auto. equalization at both speeds. Weight—Only 27 lbs.

221-24 E. Cullerton St., Chicago 16, Ill.
In Canada • ATLAS RADIO CORP., LTD. TORONTO

Deep and the paper stock very thin. The cone is flabby and delivers a satisfyingly deep thump when struck with the fingers. But, unfortunately, a new set of problems arises. The thin rim soon wear through by the action of friction among its fibrils. Insufficient physical support is given to the body of the cone, which may go out-of-round at the edges where it blends into the thin compliant rim. This causes distortion and possible loss of annular centering within the air gap. Further, there can be no assurance that the rest position will always accurately align the voice coil axially with the gap. Because the forces in the rim are removed, the cone lacks sufficient stability and may fail to find a definite rest position. The cone becomes sensitive to external mechanical vibrations. A shift of voice coil position with respect to gap alignment seriously lowers the conversion efficiency and introduces further distortion. Varying humidity conditions may cause an axial shift of the voice coil with respect to gap alignment since paper cones are hygroscopic to a certain extent. The greater the amount of the rim compliance, the greater is the amount of voice coil shift. These are some of the conflicting effects of attempts to reduce mechanical impedance, Zm, by varying rim freedom.

Peak-to-Peak Excursion

Figure 2 shows the length of path which a cone must traverse in order to radiate one acoustic watt. While this is much more power than a person needs in a living room, it is about right for an average theatre. For a 12-in. speaker to radiate one acoustic watt at 200 cps requires a maximum displacement of 1/16 in., which is easily attainable. But to deliver the same acoustic watt at 5000 cps requires a total displacement of one inch. This is not easily attainable. However, with larger cones, this problem becomes smaller. A 15-inch cone must move 0.6 in., and an 18-inch cone (not shown) must move only 0.4 in. These excursions are within design possibilities. But at 2000 cps the problem is formidable. The distances involved for the 12- and 15-inch cones. These displacements are for direct radiating cones, and are not affected by the baffle or cabinet, except when fitted to horns.

Other Causes of Distortion at Low Frequencies

1. Input distortion at high signal peaks. Radio transmitter and receiver signal peaks of 100 per cent modulation contain significant distortion. Similarly, high-level peaks on phonograph recordings contain large values of distortion. The non-linear conditions characterizing loudspeaker distortion at large cone amplitudes, likewise exist in recording heads, microphones, and some pickups. By adding to this the fact that the amplifier may be operating close to maximum output, it is seen that the loudspeaker is not the only offender.

2. Cabinet Vibration. A poorly constructed cabinet asserts its independence by taking over the function of the loud-
speaker through a limited frequency range; various flexible members are excited into resonance. The lower the desired operating frequency, the more solid and massive must be the construction of the cabinet.

3. Lack of Cone Homogeneity. Although there is usually a smooth reduction in cone thickness from apex to periphery, there must be a similar density and unit mass at any given radius from the center. If there are irregular spots of heavy and light areas, harmonic distortion may result. This is usually serious because the driving frequency is then unrelated to these harmonics. The effect of a heavier mass in one spot would be to act independently of the remainder of the cone by failing to keep up with it during the accelerating portion of the cycle and to push ahead during the deceleration periods. At high signal levels it may introduce its own resonance.

4. Irregular Response Due To Low Efficiency. Aside from some of the previously mentioned shortcomings of poor conversion efficiency, another important disadvantage must be mentioned, namely that of irregular and erratic frequency response. A run-of-the-mill speaker, such as used in commercial radio sets, may have a conversion efficiency around 2 per cent. Such a speaker may easily have a number of spiked resonances at various frequency points, where the efficiency can rise to a theoretical maximum of 100 per cent. This means a possible variation of 20 to 1 in output along its spectrum or a change of 13 db. This does not consider any dips or cancellation effects which may give sharp holes with zero output. A quality speaker with an average efficiency of 50 per cent, also may possess resonant peaks and spots where the efficiency suddenly hits 100 per cent. But this is only a 2 to 1 change in output, or a 3 db variation in pressure. This is a very small change indeed and the speaker may be considered almost flat.

ERRATA

The Simple Preamplifier and Tone-Control Unit described under that title by David H. O’Brien in the November, 1951, issue has occasioned several inquiries from readers, and Mr. O’Brien has provided a few suggestions, which are here presented. R$_a$ should be connected to the junction of C$_a$ and R$_w$, rather than to the plate of V$_t$. This occurs the need to reverse the polarity of C$_a$, since the cathode of V$_t$ is positive with respect to the output lead, which is normally at d.c. ground potential. Since C$_w$ is then included in the feedback loop, its effect is nullified by the feedback and the low bass frequencies are improved. R$_a$ should be increased to 0.1 meg. R$_e$ should be changed to 330 ohms, which would decrease the tendency for over-equalization of the high frequencies when the tone controls are set for “flat.” In some constructions, there has been a tendency to “motorboat,” and this may be eliminated by changing R$_e$ to 0.1 meg. R$_a$ to 39,000 ohms, and by changing C$_m$ to 80 µf, C$_w$ to 40 µf, and C$_w$ to 40 µf.

With the new value of R$_e$, closing the switch S, will provide the correct roll-off for LP records without the necessity of adjusting the treble tone control to effect this correction.

only ALTEC supplies a complete line of high fidelity equipment!

Attempts to adapt unrated parts together into a home music system are often unsuccessful. Buy Altec and you not only get the highest quality but you get components designed to work together. Each unit plugs into the others. Easy to install. Designed for eye as well as ear appeal. In home installations as in all other audio fields, the Altec name is your assurance of the best.

AM-FM TUNER

303A — The best tuner money can buy for audio quality ... wide band superhet AM ... superlative FM ... equalized phono preamp ... extra input for tape ... record crossover frequency selection ... equalization for LP records ... bass and treble rise and droop ... built in power supply ... more dependable features than any other tuner.

REMOTE AMPLIFIER

A-433A — Beautiful compact control unit for use with phone when 303A tuner is not required. Contains VR phono preamp and all of the novel features found in the 303A tuner ... three inputs ... perfect for reproduction from records, tape and radio tuners.

POWER AMPLIFIER

A-333A — The power amplifier without a peer ... 15 watts with less than 1½% harmonic distortion ... 47 watts with less than 5% distortion ... flat from 20-20,000 cycles ... completely controlled from 303A tuner or A-433A remote amplifiers.

LOUDSPEAKER

604B DUPLEX — Still the finest loudspeaker of its type ever produced ... proved superior time after time in critical listening tests by experts and laymen ... six other models from 8" to 15" also available.

820A — Altec’s new corner speaker system ... the concert grand of the loudspeaker world ... two 15" woofers ... high frequency speaker and multielement horn in a furniture cabinet provide famous Altec “Voice of the Theatre” quality for the home.

SEE YOUR DEALER OR WRITE TODAY
The Best British Records of 1950-1951

H. A. Hartley

Concluding the compilation of the author's preferred selections from the catalogs of English record manufacturers, chosen for good performance and technical excellence.

EARLY ENGLISH KEYBOARD MUSIC

This extremely fine collection should not be missed. The set includes twelve records, which may be acquired separately, and the following are the contents. All are Decca 78's. The record number is given first.

X514 The Lord's Masque & New Noddle. Dart (harpischord) and R. Donington (viola da gamba).

OPERA

Bizet


Lehar

Count of Luxemburg (abridged). Der Zarewitsch (abridged).

Mozart

The Merry Widow (abridged). All the above by principals and chorus and Tonhalle O. Zürich. (Reinshagen).

Strauss, J.

Die Fledermaus. Complete recording, except for dialogue.

Weber

Der Freischutz. Complete recording on three records. (Achermann).

Gilbert and Sullivan

All these comic operas are well performed and well recorded. If they cannot all be included as best buys it is simply because some of them do not seem to "come over" with complete satisfaction. The best are Mikado and Gondoliers, then Yeomen of the Guard. At the time of writing Iolanthe and Patience have not been heard, but ought to be good. See the London catalog for numbers.

OPERATIC ARIAS

Beethoven

Fidelio: Recit. & aria—In des Lebens Frühlingstagen. Pataoka & V.P.O. (Böhm).

Borodin

Prince Igor: I hate a dreamy life. Badko: The roaring waves besiege our shore. Christoff and Ph.O.

Donizetti

Elisir d'Amore: Quanto e bella. Gigli & Ph.O.

Granados

La Maja y el Ruisenor (Goyescas). de los Angelos & Ph.O.

Mascagni


Moussorgsky

Boris Godunov: In the town of Kazan & Hark 'tis the funeral bell. Christoff & Ph.O.

H. M. V. DB21097

H. M. V. DB21069

[Continued on page 52]
NEW LITERATURE

American Relay & Controls, Inc., 4039 W. Flournoy St., Chicago, III. has recently issued a new relay catalog. Attractively printed in two colors, the new booklet contains twelve pages of information of value to users of relay of many types. Included in it are sections on the selection of relays, giving the method and data required to choose a relay for any specific application. Exceptionally well illustrated. Copies may be obtained by writing on company letterhead.

The Heath Company, Benton Harbor, Mich. is distributing a new catalog which covers the entire line of Heathkit test equipment and amplifiers. Included in the detailed listings are schematics, inside photographs, applications, specifications and circuit descriptions of the various instruments. Copies may be obtained free by writing direct to the Company.

Maine Designed Products Corporation, 118 Main St., Dayton, Ohio, is issuing a 4-page technical bulletin titled "Instrument, Shine, Testing Theory and Measurement," describing in detail the use of the Maine Step Test Unit. Calculations, operation, and instrumentation are fully delineated, and oscillograms of a complete range of shock tests are shown. Will be mailed free on request.

Chicago Telephone Supply Corporation, Eidsward, Ind. illustrates and gives detailed descriptions of its new military line and regular civilian line of composition and wire-wound resistors in a new 8-page catalog which is now being distributed. Section titles in the book include: "Resistance Tapers for Variable Composition Resistors," "Locating Bobbins, High-Torque Feature, and Mounting Flanges," and "Water-sealed BoundingBox and Mounting." Descriptive material includes electrical and mechanical characteristics, special features, and dimensional drawings of each resistor.

Cannon Electric Company, P.O. Box 76, Lincoln Heights Station, Los Angeles 31, Calif. is distributing Bulletins LBB-1561 and GBS-1561, covering types LS laboratory and switchboard connectors and type GB battery connectors, respectively. Advanced technical data has been incorporated in these new editions, as well as listings of a number of new types of connectors. Both Bulletins set an exceptionally high standard for publications of this nature, will be mailed upon request.

Insulation Manufacturers Corporation, 94 W. Washington Blvd., Chicago 6, Ill. describes a wide range of insulating materials in a new 12-page booklet which will be mailed free upon request to the Company's Publications Department. Among the materials covered are rayon, paper, wood, rubber, paper, paperboard, and electrical insulating materials. Descriptions of the advantages, properties, and applications for each material, is supplied. A thoroughly interesting technical publication.

General Electric Company, Schenectady 5, N. Y. describes the application and operation of equipment used for measuring magnetic properties in an interesting new book prepared by the Company's Meter and Instrument department. Designated Bulletin UEC-777 the publication describes the GE gauss meter, indicating fluxmeter, recording fluxmeter, and flux meter calibrating unit. Also included is a great deal of worthwhile information on such items as flux density, flux direction, and total flux measurements. Copies will be supplied on request.

The Sonocraft Corporation, 115 W. 45th St., New York City, N. Y. is the latest of the country's major distributors of audio equipment to announce a 1952 cata-
log. The Sonocraft catalog is an excellent directory of sound and recording equipment and accessories. Copies may be had without cost by writing to the Company.

Coated Coil Corporation, 501-501 W. 50th St., New York 1, N. Y. graphically illustrates and describes Enamelstrip, a material coil pre-coated in color, in a 4-page folder which will be mailed on request. Enamelstrip permits manufacturers of small devices using stamped sheet-metal for exterior exterior surfaces to have considerable time, labor, and money, by minimizing or eliminating finishing processes.

**STEPSHENS**

**TRU-SONIC INTRODUCES**

The Finest Amplifier Ever Built

**THE NEW 500D DIRECT DRIVE AMPLIFIER**

HERE'S WHAT MAKES IT GREAT!

- No output transformer
- Delivers 20 watts of audio
- Frequency response ±¼ db 20-70,000 c.p.s.
- Distortion less than ½ of one per cent
- Phase shift less than 15° at 20 c.p.s.

**STEPSHENS is First Again to Raise the Standard of Excellence in Finest Quality Sound Systems**

In fine sound systems the trend is away from use of transformers. The Stephens Tru-Sonic 500 D Direct Drive Amplifier is the first to successfully eliminate the output transformer. You get 20 watts of audio plus the elimination of all distortion introduced by transformers. There is less phase shift than ever experienced with a transformer—especially on the low end. What This Means To You...clarity of tone never before experienced in sound reproduction. Full rich tones without hum and noise. When used with matching Stephens speakers having 500 ohm voice coil impedance, you experience the ultimate in fine listening. These speakers which are specially wound for use with the 500 D Amplifier are unsurpassed in excellence of sound reproduction. The discriminating listener will find no equal to these companion developments which set a new high standard in listening pleasure.

**The 5106AX, a new 500 ohm voice coil co-axial speaker. The perfect companion for the 500 D Amplifier**

See your dealer for literature on this outstanding development or write direct today!
**BEST BRITISH RECORDS of 1950-1951**

*from page 50*

**VOCAL**

- Debussy: Twelve songs. Susanna Danco acc. Agosti. Lon. LLP256
- Mussorgsky: Night. The Star. Freddit (Soprano) piano acc. H.M.V. DB1144

**MISCELLANEOUS**

The numerous "recital" L.P. records cannot easily be accommodated in a list such as this, for the quality can be variable within the confines of one record. One or two of these consistently good have been included above, but in the main they have been ignored. The following, however, are brilliant examples of playing and recording:

- Famous overtures: Zampa, Caliph of Baghdad. If I were king. The White Lady. L.P.O. (Martinson). Noon & Night, Light Cavalry. L.P.O. (Solti).

**THE SUPER TWEETER**

*from page 23*

Ious to obtain such a unit for their own use—which to date they haven't been able to do. In the original test connection, a 2-uf capacitor was used in series with a 25-ohm potentiometer, with the super-tweeter connected from the arm of the potentiometer to one end, to permit adjustment of volume. It has been found that the optimum adjustment is about 6 db down from the maximum. C.G.McP.)

---

**RADIO MAGAZINES, INC.**

342 Madison Ave., N. Y. 17, N. Y.
IRE SHOW REVIEW

[From page 28]

ways. Interest of audio hobbyists was centered in the Bacon tweeter for home music systems.

Radio Corporation of America had the distinction of presenting the show’s only exhibit in which transistors were featured. Although the little tube displays were not shown in action, there was no room for complaint in view of the excellent job that was done in showing just how transistors are made and what they are capable of doing. This display was, by all standards, one of the highlights of the entire show. RCA is to be highly commended for staffing the transistor exhibit with men who were obviously experts on the subject at hand. Of specific interest to sound engineers who visited the RCA exhibit was a new high-power audio tube. Designated TV 4401, it is one of many interesting potentials—you’ll be hearing a lot about it in the months to come.

Shallcross Manufacturing Company offered an interesting exhibit featuring an extensive range of precision measuring devices as well as a wide variety of precision-built rotary switches. The latter item, produced especially for manufacturers of fine equipment, are available in single- or multi-deck types with contact resistance as low as 0.001 ohm.

Standard Transformer Corp. stimulated attention in its exhibit with a dramatic showing of various types of Stancor transformers for a wide variety of audio, power, and TV functions. Kilowatts were the Stancor catalogs which dramatized the full extent of the company’s growth in recent years.

Sylvania Electric Products, Inc. came through with one of the show’s more popular and informative displays—an interesting showing of stamped circuit assemblies and germanium diodes. Even as it pioneered fluorescent lighting, Sylvania is now pioneering the use of germanium diodes. The effectiveness of this spade work is shown by the many new uses for the little crystals that are being discovered almost daily.

Terminal Radio Corporation lived up to its reputation as one of the country’s most progressive jobbers of electronic equipment with an enticing display which featured portable transmitting and receiving equipment. Although those of us in the audio field have come to associate Terminal entirely with the distribution of sound equipment, the company’s reputation is just as impressive in all the other phases of the electronics industry.

United Transformer Corporation had as its focal point of its exhibit an excellent showing of transformers, chokes, toroids, and hundreds of items ranging from tiny "coiner" units for miniaturized mobile equipment to large transformers for meeting the critical demands of fixed military installations—a display which was both attractive and informative.

University Loudspeakers, Inc. displayed its complete line of speakers, ranging from high-power industrial units to the tiny Model 4401 tweeter. Interest of industrial sound engineers was naturally centered in the big re-entrant assemblies, while broadcast engineers and audio hobbyists found greatest appeal in the Type 6201 coaxial system. University is one of the most alert and aggressive companies in the audio field—and the reasons therefore were clearly evidenced in this impressive display.

Waterman Products Company, Inc. displayed a tiny rectangular cathode-ray tube which makes possible even further reduction in size of the company’s famous Pocketoscopes. Also shown were several new models of the "scopes themselves—miniaturized instruments capable of doing the jobs normally expected only of full-size equipment.

---

WEATHERS One-Gram Capacitance Pick-Up

(Cartridge Form)

AT LONG LAST—REALISM without noise.

20 TO 20,000 CYCLES

Will improve and replace any modern phonograph pickup.

✓ One gram stylus pressure with ideal tone arm.
✓ Two grams pressure on modern Webster changers.
✓ Very low pressures with other players, including RCA 45 changer.
✓ Will operate properly with most good quality tone arms.

Constant Amplitude Response, 20 to 20,000 cps. 1vw into megohm at 1000 cps.

AES Response Equalization from separate output connection for LP records.

WEATHERS CARTRIDGE

AT A NEW LOW PRICE

WEATHERS power supply, complete with power cord, for 117 volts, 60 cps., net $14.50

Check or Money Order. No. C.O.D.'s. Please add 50c for postage. Shipment postpaid in U.S.

WEATHERS INDUSTRIES

510 RICHEY AVE., W. COLLINGSWOOD 6, N. J.

HI-FI FANS

Order the famous PERMOFLUX Royal Eight" SPEAKER

For Test TODAY! 10 DAY TRIAL

MONEY BACK GUARANTEE!

High Fidelity Fans the country over acclaim the clean, brilliant life-like musical reproduction of the PERMOFLUX Royal Eight"... the 8" Speaker proved comparable to any 12".

Combined with the new PERMOFLUX Corona Baffle... either singly or arranged in Multiple Speaker Units... the Royal Eight" re-creates original programs with even superior sensitivity and fidelity... every instrument in full range tonal balance.

Here's Big Speaker Performance in a small easy-to-install frame at a sensible price.

REPLACEABLE 2,000 HOURS lifetimes at 1.5 ohm or 3.5 ohm sapphire stylus on request.

PERMOFLUX CORPORATION

4932 W. Grand Ave., Chicago 39, Ill.

Please send... "PERMOFLUX Royal Eight"

(ET-8) FOR 10 DAY TRIAL

Check 

Money order enclosed

Your Name

Address

City Zone State

www.americanradiohistory.com
WE HAVE IT!

A STEPHENS FULL-RANGE
12-INCH SPEAKER

AT A BUDGET PRICE

Net price:
Model 112FR $30.87

Here's a fine Stephens speaker of top quality offered within budget requirements of average high fidelity fans. The Model 112FR 12" full range speaker incorporates an aluminum die cast frame, a heavy steel pot-structure, and a 1 1/2 lb. Alnico V magnet. It's an entirely new co-axial speaker with sonic lens for better sound distribution (90° high frequency dispersion). The deep voice coil assures outstanding low frequency performance.

List Price: F.O.B. Los Angeles, California

MATCHING CABINETS

Stephens C622 Corner Cabinet and W620 Wall Cabinet employ a new principle of horn loading. These cabinets provide a lower fundamental bass response. Improved sound reproduction, especially in small rooms is immediately evident. The cabinets are completely enclosed except for the front and do not rely on walls of the room for sound radiation. Sound radiation comes from within the cabinets. Available in fine grain blonde or mahogany high-lustre, hand-rubbed finish.

ORDER TODAY! Send check or money order. No C.O.D.'s please.

RYB INCORPORATED
251 SO. ROBERTSON BLVD.
BEVERLY HILLS, CALIF.
BRadshaw 2-1983

AUDIO IN THE HOME

[from page 25]

separate cartridges—one for LP and one for standard records—at about six dollars each, the total will then be about fifty dollars for the record player. A few dollars more will provide a dual cartridge which plays both LP and standard records. The necessary requirements in the radio section are sufficient sensitivity, freedom from background noise, and freedom from drift. It may be AM-FM or FM only. In areas like New York and Washington, FM is all that is necessary, as most good music programs are broadcast on FM exclusively, and the programs of the better AM stations are duplicated on FM. The cost of a good FM tuner will begin at around seventy dollars. AM-FM tuners cost approximately thirty-five to fifty dollars more. It might be noted that several tuners contain tone controls and preamplifiers along with the tuning knob. This would normally be an ideal arrangement for simple installations. However, we have found no tuner of this type with adequate preamplifier gain or lack of hum and noise when used with G.E. or Advent pick-ups. The tone controls, though they may be satisfactory for extreme low-cost installations, would be considered completely unusable in a high-quality, extended-range system.

Amplifier

Amplifiers, the heart of a system, may be divided into two groups: those that require approximately one volt input to drive them and have no tone or volume controls, and those that have the preamplifier and tone controls as an integral part of them. Some have the controls as a remote unit for convenience in mounting. With a tuner that has its own tone controls, an amplifier without them is used. However, the best results are obtained when the tone controls and the preamplifier are part of the amplifier. With regard to price, amplifiers are again grouped in two distinct brackets: those selling for around fifty dollars, and those for $150 and up. Those in between may have more power, which makes them suitable for PA work, but are no freer from distortion and hum at room volumes.

Speaker Housing

The exact choice of a speaker may depend a lot on the housing, the amplifier to be used with it, and the quality of the source material, whether radio or records. Among the characteristics of the speaker chamber, which determines frequency response, are its size, its shape, the material of which it is made, and how it is braced. The rigidity of the chamber is a prime consideration, and some people have even gone to the trouble and expense of making them of

AMPERITE

Studio Microphones at P.A. Prices

Ideal for BROADCASTING RECORDING PUBLIC ADDRESS

"The ultimate in microphone quality," says Evan Rushing, sound engineer of the Hotel New Yorker, "shoot right into the new Ampere Microphone—or stand 2 feet away—reproduction is always perfect.

Not affected by any climatic conditions.

Guaranteed to withstand severe "knocking around."

"Kontak" Mikes
Model SKH, list $12.00
Model KKH, list $18.00

Special Write for Special Introductory Offer.

Offer: and 4-page illustrated folder.

AMPERITE Company Inc.
541 BROADWAY • NEW YORK 13, N. Y.
Canada: Atlas Radio Corp., Ltd., 560 King St. W., Toronto

NOW... YOU CAN AFFORD THRILLING

HIGH-FIDELITY MUSIC

OWN THIS HI-FI CUSTOM PHONO-GRAPH SYSTEM
ONLY $126.95

AMPLIFIER $1 db 70-20,000 cps.

Calibrated on outstanding value by a leading product research organization...

ENJOY THE BRILLIANT RECORD reproduction you've always wanted... at a sensible low price. This NEW hi-fi phonograph system gives you the top-value Knight 20-watt amplifier, G.E. S1201D 12" hi-fi speaker and Webster-Chicago 196-27 3-speed record changer with plug-in heads and 2 G.E. cartridges. Complete with cables (no solder connections required), hard-ware and instruction. Hear your records as they should be heard... order today! Ship wt.: 57 lbs.

20 Watt Amplifier
Knight-Chicago $12 Speaker
Webster-Chicago 3-Speed Changer
G.E. Hi-Fi 12" Speaker

FREE 212 Page Hi-Fi, TV & Radio Catalog
The complete Buying Guide to everything in Hi-Fi, Radio, TV and Electronic equipment. Unsurpassed for quality apparatus and fine values. Ask for your FREE copy today.

ALLIED RADIO
833 W. Jackson Blvd., Dept. 17-11, Chicago 7, Ill.
brick or concrete. This is an extreme, of course, but those who can afford it are amply rewarded by the results. Today there are many moderately priced speakers that have gained respect. In choosing any of them, the housing must be considered simultaneously, and the size of the cabinet that is available may determine the speaker chosen. For example, if only 2 cubic feet of space are available, a Western Electric 754A, which is specially designed for small spaces, is best, but this must be tightly closed and completely padded, or the bass will be unnatural. It is also necessary that the amplifier have sufficient power and low distortion at frequencies below 100 cps, and this is generally not true of any amplifier in the fifty-dollar bracket. Most such amplifiers, when used with an 8-in. speaker usually do not have sufficient bass. To balance this, a 15-in. speaker good in the bass register is often the choice with an inexpensive amplifier. Many people, upon hearing this, ask the question, "But isn't a 15-in. speaker too big for my little room?" We have always felt that because we must play music at low volumes and need as much bass as possible to compensate for hearing losses, the intensity of the bass spectrum must be increased, and this can be done more successfully with a 15-in. speaker than with a smaller one. Even though most people will not house the speaker in a large enough enclosure, the larger speaker will have better bass response, despite the small cabinet. The volume at which we play our system will also be made a difference in the power handling capacity of the speaker selected. Here, efficiency plays a big part. For example, one speaker that is 10 db more efficient than its competitor will require only 1.5 watts of power to give the same acoustic loudness in a room as will 15 watts driving the other. It can be seen readily from this that, with the less efficient speaker, the amplifier must be capable of much higher powers on peaks. This, again, is a shortcoming of low-priced amplifiers, and it might be said from this that more efficient speakers will sound better with inexpensive amplifiers than with cheaper and less efficient speakers.

Distribution, whether dispersed or beamed, is another factor in choosing a speaker. High frequencies have a tendency to be scattered, and consequently would not be satisfactorily heard by certain speakers unless a person sat in front of them. Smaller speakers have better dispersion than the larger ones, and generally speakers in corners give better dispersion and better low frequency response, as the walls of the room act as a large megaphone. In catalogs, one sees a claimed frequency response of 40 to 15,000 cps, ±3 db. We do not believe that a speaker could be made with such a response that would cost less than several hundred dollars. More than extended frequency response is important in a speaker: Freedom from peaks or annoying resonances is also desirable. Good transient response,
Hi-Fidelity
10 tubes

AC operation
Use with any amplifier or TV set

Never such a bargain in FM's history.

Brand new PILOT tuner with $130-tuner features.

(1) separate FM and AM 3-gang tuning condensers; (2) tuned RF stage on both FM and AM; (3) built-in FM and AM antenna for local reception; (4) terminals for outside antenna; (5) temperature-compensated oscillator; (6) high-Q HF coils; (7) iron-core IF's; (8) AVC; (9) advanced AM and FM ratio detector circuits; (10) 4-position switch for AM/FM/mono-TV or recorder; (11) selective FM/AM pilot lights; (12) miniature tubes throw-out; (13) built-in dual-filtered AC power supply; (14) compact size—only 11 3/4 X 7 1/8 X 11/2" over-all 15 lbs.

For only $12.95 you get this $69.95 Pilot tuner complete with tubes, knobs, brown-and-bronze escutcheon, and built-in mounting brackets.

ORDER NOW — PROMPT SHIPMENT WHILE THEY LAST

BARGAIN ACCESSORIES, TOO!

POLARIS STYLUS CARTRIDGE

$5.70

g. POSITION EQUALIZER

$11.95

SPECIAL "PACKAGE DEAL"

FM/AM tuner, GE dual cartridge, GE pre-amplifier, Garrard 3-speed changer, and 12" co-axial PM speaker with built-in cross-over network. Value $185.50. Yours for only $124.50. Speakearring FREE!

RADIO SHACK CORPORATION

167 Washington St., Boston 8, Mass.

or the ability to stop vibrating the instant after the sound has ceased, is essential. Poor transient response gives an effect which is analogous to blurring or "out of focus" in photography. It is important to choose a speaker and amplifier that are compatible. Where standard components are used, one must choose between an expensive amplifier with an inexpensive speaker, properly housed, or the more usual inexpensive amplifier with a heavy 12- or 15-in. speaker.

The placement of components with relation to one another, ventilation, and so on, will affect the results obtained. Poor ventilation will cause excessive heat in tubes which, in turn, will cause FM tuners to drift excessively. Magnetic pick-ups of variable reluctance type are susceptible to stray magnetic fields from power transformers, chokes, and motors. This can be checked by setting the pick-up on a record, removing the power cord of the turntable, and moving the amplifier around it to see where the minimum hum occurs. This problem is more acute with some pick-ups than with others.

Employment Register

Positions open and AVAILABLE personnel may be listed here at no charge to industry or to members of the Society. For insertion in this column, brief announcements should be in the hands of the Secretary, Audio Engineering Society, P. O. Box 12, Old Chelsea Station, N. Y. 11, N. Y., before the fifth of the month preceding the date of issue.

- Positions Open • Positions Wanted

★ Sales Manager, Audio-Visual Aid Department. Excellent opportunity with large organization in New York area. State experience and salary desired in first letter. Box 401, Audio Engineering.

★ Radio and TV Engineers, for administrative engineering. Attractive salary with escalator clause. EE degree or BS in Communication required, but no experience necessary. For appointment, contact Mr. James Anderson at Circle 7-300, Ext. 494. National Broadcasting Company, 30 Rockefeller Plaza, New York 20, N. Y.

★ Engineers and Scientists urgently needed for work on highly important projects of interest to national defense. Chemical, Electrical, Electronic, Industrial, and Mechanical engineers required. Physicists and Metallurgists also needed. Projects involve research, development and manufacture of artillery ammunition, small arms ammunition, electronic fuses, fire control instruments, etc. Salaries range from $3410 to $7600 per year. For further particulars, write to Mr. K. E. Yocum, Director, Civilian Personnel, Frankford Arsenal, Philadelphia 37, Pa.

IF YOU BUY ON SPECIFICATIONS

and tops in value, you'll buy the TWIN-TRAX* TAPE RECORDER

"Choice of Engineers Everywhere"

Compare the guaranteed specifications of a Twin-Trax Tape Recorder with any other recorder in any price class. You'll find that Twin-Trax gives you more features, better all-around performance and more value for your money.

Complete specifications, performance ratings and direct factory prices in our catalog 5109. Send for it today.

*Trademark Reg.

AMPLIFIER CORP. OF AMERICA

398 Broadway, New York 13, N. Y.

ACOUSTICS ENGINEER

Capable of handling the following:

- Noise problems in and around the airport.
- External muffling of noise from aircraft.
- Design of aircraft to reduce noise generated.

Acoustical treatment of aircraft interiors.
- Acoustic problems in offices and manufacturing areas.

You'll Like Working for M.A.C.!!

Send complete resume to:
Technical Placement Supervisor
MCDONNELL AIRCRAFT CORPORATION
St. Louis (3), Missouri

STILL AVAILABLE

ULTRASONIC FUNDAMENTALS

By S. YOUNG WHITE

The rapid increase in the use of ultrasonic during the last few years makes it natural that the well-informed sound engineer should want to learn something of the limitations and possibilities of this field. By reading these fundamentals you can soon learn enough to do professional work.

Elementary in character, ULTRASONIC FUNDAMENTALS was written originally as a course of extension material for the purpose of acquainting the service in this field with the enormous possibilities of a new tool for industry. It covers the double purposes of sound in industry—measurement and production.

CHAPTER HEADLINES

- Ten Much Audio Opportunities in Ultrasonics.
- Elements of Ultrasonics. Essential Ultrasonics. Convoluting Ultrasonic Energy to a Load. Ultrasonics in Liquids. Ultrasonics in Solids. Testing by Ultrasonics. High-Power Ultrasonic. Notes on Using High-Power Ultrasonics. Application of Ultrasonics to Engineering Economics of Industrial Ultrasonics. The applications of ultrasonics have already extended to many industries, and as its possibilities are explored they will increase a hundredfold. To keep ahead of the game, engineers need to know what they are doing, and the techniques of applying ultrasonic treatment to new processes.

ULTRASONIC FUNDAMENTALS

By S. YOUNG WHITE

36 pages, 40 ill., 8 1/2 x 11, paper cover $1.75

Book Division, Dept. A
RADIO MAGAZINE, INC.
342 Madison Avenue, New York 17, N. Y.

56

AUDIO ENGINEERING • APRIL, 1952

www.americanradiohistory.com

These Reports will keep you up-to-date in this ever-changing industry. They will also help you to buy and specify to best advantage. A complete description of most products will be found in the Official Buying Guide, Radio's Master—available through local radio parts wholesalers.

BOOKS & MANUALS

MISCELLANEOUS RADIO, TV AND ELECTRONIC PARTS
ACOUSTIC-CRAFT: Two-speed prices on "Deluxe" Bass and Cabaret Cabinets from $120.00 net each added $60.00 at $72.00 net.
ELACTRO-MECHANICAL INSTR. CO. Additions to their line of transformers $187.00 and 306, while adding motors 2090A and 2013A.
ERIE RESISTOR Added G15-60000, completely universal Hi-Voltage Resistors at $3.55 net and trolley cars for $60.00 net.
GIBSON SET CO. Added VHF amplifier with switch at $79.00 net.
HALDORSEN CO. Increased their entire line on transformers to include new items, dimensioned lines, price changes, and new catalog numbers.
NATIONAL CARBON Added #279, "Sdrag," 500,000 to 1,000,000 ohm, for variable resistors. #1651, "Dracony" Flashlight; and #1271 "Dracony" battery lamp and emergency lamp holder. Add to their entire line of transformers.
PORTER & DRUMFIELD. Window Soundomono Utility Tower and Dual Inclined, from their line.
SANGAN ELECTRIC CO. Added approximately 265 new VHF transformers.
WIRT CO. Withdrawed #20711 and #20711A from their line of B&v-4 Kits and Baskets.

RECORDING EQUIPMENT, SPEAKERS, AMPLIFIERS, NEEDLES, TAPE, ETC.
DUOTONE CO. Added 36 new Diamond Replacement needles to their line.
JEWEL INDUSTRIES. Added Jewel rolling needles #207-6C, Wilensky Gay (Roboril) entire playback combination for 78-r.p.m. records and WD-652, Wilensky Gay (Roboril) entire playback combination for 33 1/3, 45, and 78-r.p.m. records.
NACCO (Mark Simon) Decreased prices on approximately 101 items on their line, dimensioned space items and added MA-77, Amplifier; MA-775, Remote Control Amplifier; MO-77, Outdoor System; MR-77, Booster Amplifier and MR-77P, Booster Amplifier with remote.
PEMFLEX CORP. Increased price on Magnadisc Rosetta #2515-1R, DBR-100, DBR-175P and DBR-215. added three new speakers, ECM and 45-19 to their "Champion" line and 1595-1 to their "Earth" line.
PFAFFENBACH CORP. Added PA-102A, PA-157M, and PA-825F. Prometheus Replacement needles (Bruce Winder-type for Std. groove, Microgroove, and All Purpose). Also added RT-10 "Champion" replacement tone arm for V-M changer #490 series and RT-11 for 900 series at $3.00 net.
PICKERING & CO. Withdrawed #161L and 161M. 78-r.p.m. 10-in. and #155L, Universal Pre-Amplifier Unit.
RECORD CORP. Increased prices on four "Bosston" replacement needles #595, 596, 597, and 310. added "Boston" replacement needles No. 150 and 555. added 11 "Boston" replacement needles.
SHURE BROTHERS. Reduced prices on microphone cartridges (microphone) #101C and 102C to $16.50 net. reduced prices of microphone reproducers #105 to $40.00 net.
VIBRALOC CORP. Reduced prices on "G", "B", and "K" series of loudspeaker baskets.

TEST EQUIPMENT
ELECTRONIC MEASUREMENTS CORP. Added Model 285 and 2801, Tube Tester; and HFP, High Voltage Probe.

PHONOGRAPH ENTHUSIASTS!
TERMINAL has your ticket to finest phonograph enjoyment.
For those who demand the purest reproduction of fine music—TERMINAL has devised a truly excellent, ear-balanced system for your complete satisfaction!

KORNER KABINETS — KK12
Acoustically superior to any conventional-type speaker housing. Full-size enclosed reflex chamber with the walls of the room as the resonance chamber. No partition, no sound absorbing pads, speaker mounting board. For 12" speakers $36.50, 15" $80.00. 21.00 per pair. Shipping container, 2.50 addl.

STROMBERG-CARLSON RF-71
WIDE-RANGE SPEAKER
100-degrees angle of sound distribution over entire frequency range. Cardioid directivity. Inexpensive, yet professional. 1/3", 3.5" dia., 3/4" depth. With mounting ring.
44.58 per pair.

GARRARD "M" 3-SPD RECORD PLAYER
Perfect for LP listeners—fully automatic record changer from famous GARRARD changer, except for manual channelling. 4" full, heavy duty motor, weight-balanced tone arm, with 4L triple-play cartridge. Complete with GLE-three play cartridge.
33.00 per unit.

APPROVED A-800 PREAMPLIFIER
Ideal for use with Williamson circuits. In one complete unit, a 4-stage preamplifier with inputs for magnetic pickup cartridges, radio tuner and crystal cartridge. Separate bass and treble controls, 2-position compander network. Uses two 717 dual triodes. 12V, W, D, N.
36.75 per unit.

NOTE: This combination provides one of the finest sound arrangements we have tested. We recommend the necessary interconnections and plug set for two to THREE TERMINALS.

RADIO CRAMFISHER C-500
A new 15-watt ultra-fidelity amplifying system for the phonograph circuit. Gives the remarkable performance for which his equipment is famous. Frequency response 20-20,000 cps ± 0.5 db. Total harmonic distortion less than 0.7%, at average listening level below 1 watt.
99.50 per unit.

SPECIAL! While They Last! WEBSTER 100-4 RECORD CHANGER
3-speed, double-needle cartridge. Guaranteed new, never before manufactured, close-out. (Sorry, no mail orders on this item.)
21.95 per unit.

JIM LANSING, first in fine sound

JIM LANSING SOUND, INC.
2439 Fletcher Dr., Los Angeles 39, California

Audio Engineering • April, 1952

Directional characteristics of the acoustical lines at 500 cycles.

The new Jim Lansing acoustical lens gives the high smoothness your ear will appreciate instantly! The new lens, a natural development brought about by the inadequacies of the multi-cellular horn, distributes sound constantly and uniformly over the entire audio spectrum—giving the highs a smoothness impossible to match by any other method.

Drop into your high fidelity dealer and ask for the full story.

JIM LANSING

57
Air-Tone

HEADQUARTERS FOR SOUND EQUIPMENT

NEW SENSATIONAL COLLARO
3-SPEED RECORD CHANGER

Available with the new orthodynamic
Faucet with Twin-point Styles
NEWCOMB AMPLIFIER

Complete line of High Quality Amplifiers, from
small single units to large rack installa-
tions

Air-Tone

SOUND AND RECORDING CO.
1527 CHESTNUT ST.
PHILA. 2, PA. • R1-6-8388

RADIO MFG. ENGINEERS, INC. Discontinued Model
NSF-4, Built Detective

TOOLS AND HARDWARE
PLYMOUTH RUBBER CO. Decreased prices on their Slip-
Mount Cushion type and Diamond Rubber base and
rubber splinting compound . . . . Also SlipMount Friction in Dis-
Count Colors.
YANCEE BROS., INC. Reduced prices on Dayton Brand
friction tapers . . . . Dayton Rubber Insulating tape and
Diamond Rubber Insulating Rubber parts . . . . Diamond Rubber
rubber tape

TUBES—RECEIVING, TELEVISION, SPECIAL
PURPOSE, ETC., •

ELECTRONICS, INC. Decreased prices on 56 items on
their list of discount tubes and grid-controlled rectifiers
(Thyratrons).
G. F. Decreased prices on two 10", two 12", and
two 16" TV tubes

NATIONAL ELECTRONICS Added Ignition Type 9NE1-1001
at $37.50 net.
R. E. A. Reduced prices on receivers tubes to show 191
pricel reductions and 10 price decreases. All decreased
prices of electron tubes 807/3, 2043 and 201A.
Decreased prices of 4077A, 40775 at $35.75.
Tube—electrode tetrode 6146 and 6159.
VF amplifier power amplifiers; and 6101, UFO power tube
Rauland Corp. Decreased price of picture tube 55679A
at $43.50 net,, withdrew picture tubes 1067A and 16AP1
and increased price on picture tubes 17RPI and
17RP1E to $57.90 net.
Raytheon decreased prices of special purpose tube type
CK. 100E to $5.65 Super 9 net. (Full-rate OAS) . . . .
Added receiving tubes 178BT at $5.50 List, a		 litre
bricks of miniature construction designed primarily for
use as a cased amplifier at frequencies below 200
milliseconds . . . . Also 6312 at $3.90 list, a single
minidrome level-cutoff tube, designed for use as a
dumper diode in television sweep circuits. Interduced
other picture tube 15679A at $49.25 available from
their serving warehouse.

SHARLES TAYLOR, INC. TV tubes decreased in price.
Sylvania decreased prices on 33 receiving tube types
decreased price of special purpose tube device 5940D
and 1947NT to $1.97 net. ONRT14T to $2.75. . . . One pressure
resistor tube B-10 at $1.75, 1/2 B-10 at $1.75
Krintons 16124 and 36619 ( Velocity-modulation rect
amplifiers) to $100.00 net. Added Germantown crystal
diodes 13180 (2,500 volts) and 13190 (5,000 volt
s).

TUNE-OPEN ELECTRIC INC. Increased price of rectifying
tube D1277T to $2.00 List.

B’CAST SHORT CUTS

while they are in place, are often forgot-
tten, and the protection of the inter-
locks is lost. In the case of equipments
where the interlocks are directly in series
with the main power breaker, the pro-
tective circuit shown in Fig. 3 can be
used to eliminate positively any for-
gottenness on the part of the operator.

The protective relay, R y, should have a
6- to 12-volt a.c. coil that will operate
approximately the same current as the
power relay, R y. If the impedance
is too high, a shunt can be used. In opera-
tion, push-switch S, which is mounted
near the on button, is pushed simulta-
nously with the latter. This temporarily
shorts out the contacts on R y, which
closes and locks up, closing the circuit
shorting out the interlock string and
completing the circuit of the power con-
tactor. When the off button is pushed,
the circuit is de-energized, and the pro-
tective relay opens. In order to operate
again, the same procedure must be fol-
lowed. This will prevent the high voltage
being applied while one has his hands insi-
de the equipment. Also, the shunt is
automatically removed each time the
driver is pushed, shorting the contacts of
the relay. When the doors are closed while power is still on, the
protective relay is shorted out, thus re-
leasing its contacts, and returning the
protection of the interlock circuits. If
desired, for operation with the doors
open during emergencies, a second con-
tact on R y, can be used to operate an
indicator.

CLASSIFIED

Rates: $10 per word per insertion for noncommercial advertisements; $25 per word for commercial ad-
vertisements. 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, INC. bux and sells quality high-fidelity sound systems and components. Guaranteed and used and new equip-
ment. Catalogue. Department AF 195-19
Hillfield Avenue. Jamaica 32, N. Y. Telephone
OL 8-0145.

PRESTO 6NM small and microgroove re-
corder and 500 amplifier. Excellent condition. $900. R. Woodburn, 8 College St., Iowa City, Iowa.

FOR SALE: Meissner L-1091C AM-FM
tuner. One year old, used very little. Perfect condition. Special price $145.50. Have
550 over net price. Herbert Louis, 2914 Elin
Rd., Louisville, Ky.

FOR SALE: Twin-Trax 15-in. per second
microphone mechanism, ACA Model 804C;
in excellent condition. $95. Donna Brown,
1800 Watton, Mobile, Mo.

WANTED: Used recorder—Concertone,
Magnecorder, or similar. S. Yulec, 210 Lin-
den Ave., East Orange, N. J.

WILL TRADE my 18-in. Electra-Voice,
5-in. Jim Lansing, Stephens Hyman, 4-way
KV network, PICKERING arm and 201 diam-
cardridge, weighted turntable. Want especially
150-200, 1960, 401, 404, 408, 409, 410,
and new equipment. Catalogue. Special price for
$195 cash. Virginia Lane, Springfield, 11.

NEW Williamson amplifiers, $97.50. Hill-
crafters 8-4-C, best offer. New, cartoned
Electra-Voice B-202-Q output trans, $25. Dr. Nicely,
Kenton, Ohio.

FOR SALE: Tuners AM-FM—Brooks ST
850; Browning R-30; Amplitone—Altec Lansing A-425, $75; Spears—Jen-
gers JAP-55, $55; General Electric S-1201D
$14; Altec 600, $50; Electra-Voice EP-15, $60.
Tweeters—University 4402, $16; Uni-
versity 4401, $16; Electra-Voice TQ, 9-in.
Crossover Network—University 4439, $16;
University HLP Filter 4440, $3; Electra-Voice
X35, $.99. All in good condition. Ralph Asp-
worth, Chardon City, Mass.

FOR SALE: Altec Lansing Model 60B
speaker, $95. C. M. Carr, 341 Nova Lane,
Mendon, N. Y. Call Union 4-9471.

FOR SALE: Stephens 195FR speaker,
never used. T. P. Hurley, Pownal, Vt.

ELECTRO-VOICE "Slim Jim" Professional
microphone, Model 635, $35. Matched pair Pickering diamond
10-in., $95. Matched pair Pickering diamonds, 78
and 83, $100. Concord 5-in., $30. Telefunken RC-90 3-speed changer with来onax base,
old, perfect condition, $30. Money orders only, f.o.b. New York. R. Reiss, Box
CA-5, AUDIO ENGINEERING.

MINTYOUR center enclosure for 15-in.
woofer and 2-way system. Beautiful limed
cork, cost $200, for $150. 2 months old. Must
be seen to be appreciated. Call after 6 p.m.
Lincoln 3-8170.

WANTED: Model T-12 or T-122F Beck-O-Knit turntable, with or without arm. Give condi-
tion and lowest price. Box CX-2, ARCO Ex-

directory

PROFESSIONAL DIRECTORY

Custom-Built Equipment
U. S. Recording Co.
1212 Vermont Ave., Washington 5, D. C.
Lincoln 2-7050

AUDIO ENGINEERING • APRIL, 1952

58

www.americanradiohistory.com
Industry People

F. M. Slaymaker, chief engineer of Stromberg-Carlson's sound-equipment division, chose occasion of I.R.E. convention to huddle with Mr. E. S. Engel, district manager in Manhattan area, regarding company's new high-fidelity line which is to be introduced in May. ... Eleanore I. Ney, public relations counselor, announced that the electron|ics|field, also latched onto the I.R.E. clamor as an expedient means of reaching clients'-old, new, and hoped-for. ... Arnold R. Bailey, former Bell Lab antenna expert, announces association with Northeastern Engineering, Inc., Manhattan, N. Y. ... Mario Cortes, associate conductor of New York Philharmonic orchestra, rapidly achieving authority in the audio field to equal his standing in the field of music—has home installation which includes Magnecorder, McIntosh, 50-watt amplifier, and Altec 641B speaker.

Jimmy Carroll, formerly of G. Schirmer, Inc., music merchants, is new addition to sales staff of Harvey Radio Company's sound department, both in New York and Los Angeles. ... Charles Urban, pioneer in the transformer field, announces association with Fararitan Electric Co., Newark, N. J. ... Ken Prince, head man of Chicago's Radio Parts Show, made flying trip east to sew up details of Windy City's Audio Fair with Harry N. Beiser, Fair manager in both cities. ... Tom Marchiano, formerly in the business of selling sound equipment to consumers, now calling on distributors as representative of Mone- bar Corporation, New York—first assignment is to popularize the new Colliar record changer.

John S. Beyea, president, Magnecord, Inc., Chicago, overwhelmed at reception accorded new Magnecordette during introductory showing at I.R.E. Convention—ditto Spec Barker, sales manager, and Dick McQueen, ad manager. Jerry Minter, chief engineer, Measurements Corporation, Boonton, N. J. and a CBS official, spearheading movement of engineers toward aviation as a hobby—shares honors with Arthur Godfrey as owner-pilot of a Navion. ... Sidney Drn, responsible for a number of years for the excellent art and layout work in Lafayette Radio catalogs, has resigned to perform similar chores on a free-lance basis for all comers. ... Paul Milton, formerly assistant general manager of Crosley Dis-tribution Corporation of New York, has been appointed treasurer of the Magna-creat Corporation, also New York—an- nouncement made by Charles E. Rynd, Magna-Creat board chairman.


Max Graf, senior partner of brokerage firm of Townsend, Graf & Co., is new addition to board of directors of Audio & Video Products Corp., New York. ... Joseph Marrese has been named assistant to Bernard L. Cahn, general sales manager of the Insull Corporation of America. ... New officials of West Coast Electronic Manufacturers' Association are: Leon H. Unger, president, Wool E. Porter, vice-president; J. J. Halloran, sec- retary, and George Clarke, treasurer. George Halkides and John Tanen are new executives of James E. Lawson Sound, Inc., Los Angeles, according to announcement of William Thomas, presi- dent, ... George Davis is new Portron representative for, Southern California and Arizona. ... Edward J. Content back home after several years as senior engineer in construction of Saudi Arabian Govern- ment Broadcasting System installations at Jeddah and Mecca. Work was per- formed by International Standard Elec- tronic Corp., the former firm of William J. Boyle, former general sales man- ager, has been named eastern district manager, charge of sales by Antastic Corp., Conneaut, Ohio.
MORE ABOUT SPEAKEASIES

Last month we said that the speakeasy was an instance of co-operative trading. We also said that you would get the whole story if you became a dollar subscriber to our technical data and news service. This still holds good, but you might like to have some line on what we are getting at.

The 215 speaker is the most unusual speaker in the world because it doesn’t sound like a speaker at all; it sounds like the real thing. This, we know, seems just sales talk, but the fact remains that every newcomer to the 215 has readjusted his ideas on sound reproduction, and having done so, he then realises he has been listening for years to more or less high fidelity, rather than realism.

Realising that the process of readjustment must, in fairness to the would-be customer, be done under conditions of minimum risk to him, we invented the speakeasy system of marketing, whereby he was given the opportunity of hearing the 215 in his own home on his own equipment, at a negligible expenditure.

The success of the scheme, from our point of view, was wholly dependent on the performance of the speaker. If this was not so good, then not only the tester but several of his friends soon knew all about it. If it was good and he wanted to keep the speaker, then it cost him a good deal less than the list price. That was the reward for his taking a sporting chance.

The speakeasy scheme set up many new centers of interest for music-lovers, and continues to do so. It is an integral part of our scheme for getting realistic reproduction into American homes at very low prices. While we design for the best possible results, we also believe that those results should be available to as many people as possible. When you deal with us, you will be glad to find that the best is not the dearest.

By now our subscribers will have heard how our plans are developing for still wider production and distribution in the U.S.A. Like the speaker, our marketing policy is completely different from that of others, but like Hartley-Turner reproduction, it is realistic. If you are not a subscriber, the cost is just one dollar bill.

But at least you can have our catalogue for just the asking. We shall also send you a comprehensive technical report on the speaker itself.

H. A. HARTLEY CO. LTD.
152, Hammersmith Road
London W.6, England

ADVERTISING INDEX

Acro Products Co. ........................ 57
Air-Tone Sound & Recording Co. ........................ 58
Allied Radiop Corp. .................................. 56
Altec Lansing Corp. ............................. 49
Ambertone, Inc. .................................. 54
Ampex Electric Corp. ........................ 5
Amplifier Corp. of America .......................... 48, 56
Arnold Engineering Co., The .................. 9
Atlas Sound Corp. .............................. 59
Audax Co. ........................................... 37
Audio Devices .................................. Cover 2
Audio Instrument Co. .......................... 48
Audio & Video Products Corp. ............. 4
Bell Telephone Labs, Inc. .................. 14
Brook Electronics, Inc. ...................... 59
Cannon Electric Development Co. ........... 8
Carter Moto Co. .................................. 47
Chicago Transformer Co. ....................... 40
Classified Ads .................................. 59
Daven Co., The ................................ Cover 3
Garrard Sales Corp. .......................... 58
Gates Radio Co. ................................. 13
Gray Research & Development Corp. .......... 10
Harrison Radio Corp. .......................... 39
Harley, H. A., Co. Ltd. ......................... 60
Harvey Radio Co., Inc. ......................... 35
Heath Co., The .................................. 11
Hudson Radio & Television Corp. ........... 44
Lafayette Radio .................................. 59
Lansing Sound, Inc., James B. .............. 57
Leonard Radio, Inc. .......................... 43
Magneord, Inc. ................................. 45
McDonnell Aircraft Corp. ..................... 56
McIntosh Engineering Labs, Inc. .......... 47
Minnesota Mining & Mfg. Co. ............... 7
Partridge Transformers Ltd. .................. 60
Pentron Corp., The ................................ 48
Perrinflex Corp. .................................. 53
Pickering & Co., Inc. .......................... 33
Professional Directory ......................... 58
Radio Corp. of America ...................... 30, 31
Radio Shack Corp. ............................. 52
Reeves Soundcraft Corp. ....................... 3
Rel-Kut Corp. .................................. 1
R.Y.B., Inc. ...................................... 54
Sams & Co., Howard W. ......................... 50
Sonocraft Corp. .................................. 55
Stephens Mfg. Corp. ........................ 51
Terminal Radio Corp. .......................... 57
Triad Transformer Mfg. Co. ................. 2
Tung-Sol Electric, Inc. ......................... 7
Turner Co., The .................................. 41
U. S. Recording Co. .......................... 58
United Transformer Corp. ..................... Cover 4
Weather Industries ........................... 53
Westrex Corp. .................................. 46

PARTRIDGE WILLIAMSON
OUTPUT TRANSFORMER
Built to the original specification

De-luxe model now available from stock from all important Radio Stores throughout the U.S.A. (Price $26.00 duty paid)

This transformer is now accepted as the most efficient in the world. According to "Audio Engineering" (Nov. 1949), there is no U.S. equivalent. Thousands already sold in the U.S.A.

Partridge CF8 Output Transformer, accepted as without rival. Series leakage induct 10 mh., primary shunt induct, 130 H., with "C" core construction and hermetically sealed. (Price $40.00 duty paid)

The Following Stores are among those now stocking Partridge Transformers:

Harvey Radio Co., Inc. 103 West 43rd Street, New York 18.
Electronic Wholesalers, Inc. 2345 Sherman Ave., Washington, D. C.
Radio Electric Service Co., Inc. 311 W. Baltimore St., Baltimore 1, Maryland.

If you are unable to purchase Partridge Transformers in your city, write to us and mention the name of your dealer.

Fullest data, including square-wave tests, distortion curves, etc., together with list of U. S. stockists, rushed Air Mail to you.

PARTRIDGE TRANSFORMERS LTD.
TOLWORTH, SURREY, ENGLAND

put 'er here, partner!

500,000 Mail boxes in the United States are your partners in the fight against cancer. A contribution addressed to "Cancer" in care of your local post office will help guard your family, yourself and your community.

Next time you see a mail box, "put 'er there, partner!" ... as generously as you can.

AMERICAN CANCER SOCIETY
Here is my contribution of $ in support of the Cancer Crusade.

Name ____________________________
Address __________________________
City ____________________________ State

AUDIO ENGINEERING • APRIL, 1952

www.americanradiohistory.com
The New Daven Electronic Voltmeter, Type 170-A

is a superior, portable instrument, ideal for general laboratory and production use. It is built with typical Daven precision to measure accurately A.C. sinusoidal voltages over a frequency range from 10 to 250,000 cycles and a voltage range from .001 to 100 volts.

- Large, easy-to-read illuminated, meter scale on which all readings may be made.
- Accuracy ± 2% over entire frequency range.
- Output jack and separate volume control for using Voltmeter as wide-range, high-gain amplifier.
- Construction permits readings independent of normal power line variations.
- Meter scale has both voltage and decibel ranges.

* LIMITED NUMBER AVAILABLE FROM STOCK.
Many people realize and take advantage of the fact that "the tough ones go to UTC." Many of these "tough ones," while requiring laboratory precision, are actually production in quantity. To take care of such special requirements, the UTC Laboratories have a special section which develops and produces production test equipment of laboratory accuracy. The few illustrations below indicate some of these tests as applied to a group of units used by one of our customers in one production item of equipment:

The component being checked here is a dual saturable reactor where the test and adjusting conditions necessitate uniformity of the complete slope of the saturation curve. The precision of this equipment permits measuring five widely separated points on the saturation curve with saturating DC controllable to .5% and inductance to .5%.

Servomechanisms and similar apparatus depend, to a considerable degree, on phase angle operation. The transformer adjusted in this operation requires an accuracy of .05 degrees phase angle calibration under the resonant condition of application. With wide change in voltage and temperature range from -40 to +85 degrees C., the phase angle deviation cannot exceed .2 degree. To effect this type of stability, specific temperature cycling and aging methods have been developed so that permanent stability is effected.

This test position involves two practical problems in a precision inductor. The unit shown is adjusted to an inductance accuracy of .3%, with precise (high) Q limits. It is then oriented in its case, using a test setup which simulates the actual final equipment so that minimum inductive coupling will result when installed in the final equipment.

The hermetic sealing of transformers involves considerable precision in manufacturing processes and materials. To assure consistent performance, continuous sampling of production is run through fully automatic temperature and humidity cycling apparatus. It is this type of continual production check that brings the bulk of hermetic sealed transformers to UTC.