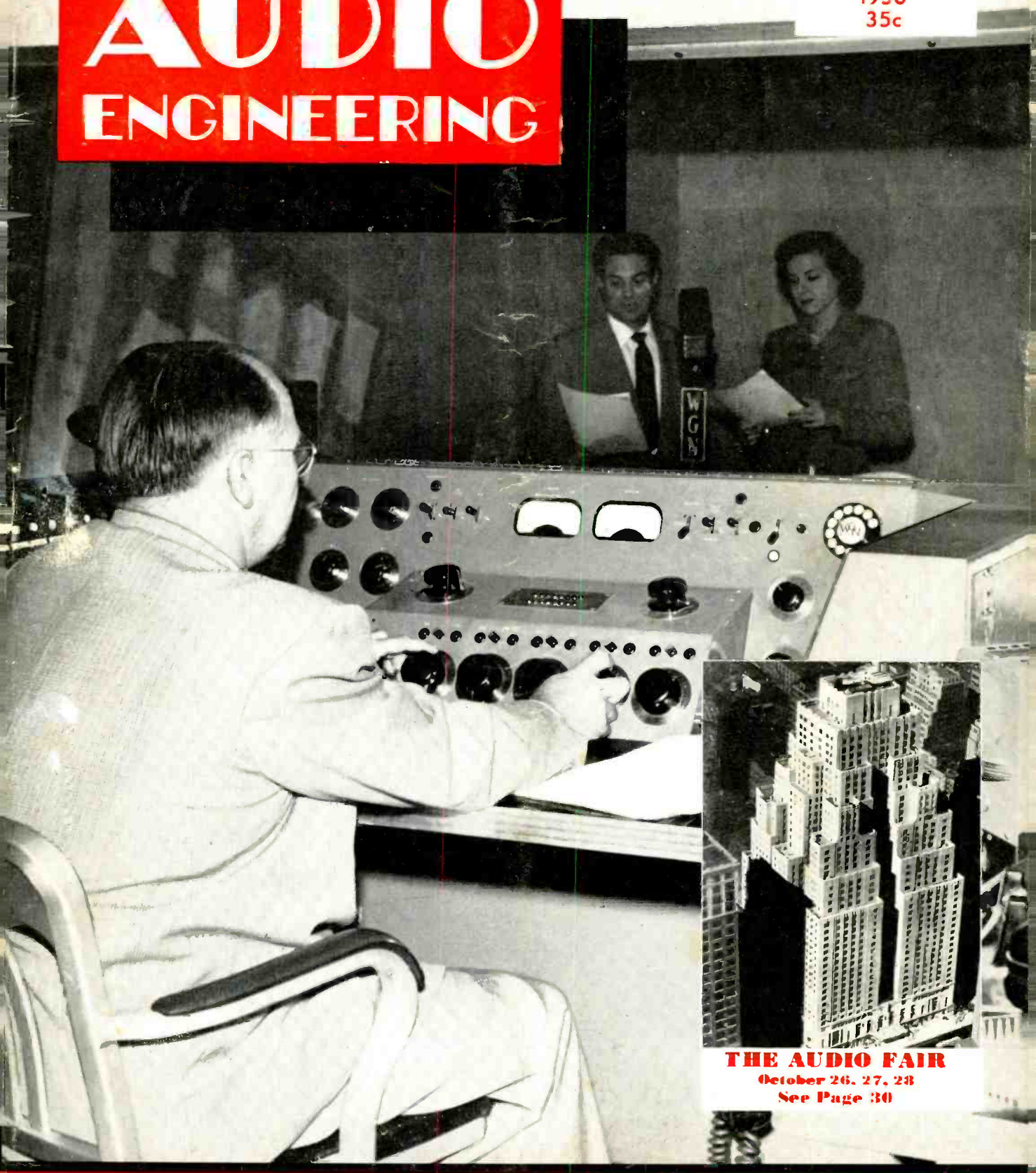
AUDIO ENGINEERING

OCTOBER
1950
35c



THE AUDIO FAIR
October 26, 27, 28
See Page 30

Published by RADIO MAGAZINES, INC.

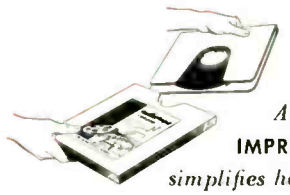
Look at the new audiotape*

Yes, you can actually *see* the difference. The way it tracks and winds absolutely flat, due to superior, straight-line slitting. Its smooth, non-curling flexibility—and the way it rides snugly over the heads without humping away in the middle. And, compared under a microscope, you can see Audiotape's *superior dispersion* of the oxide particles—free from "clumping" which tends to increase background noise. You can tell a lot just by looking at Audiotape, but...

Listen to its matchless reproduction

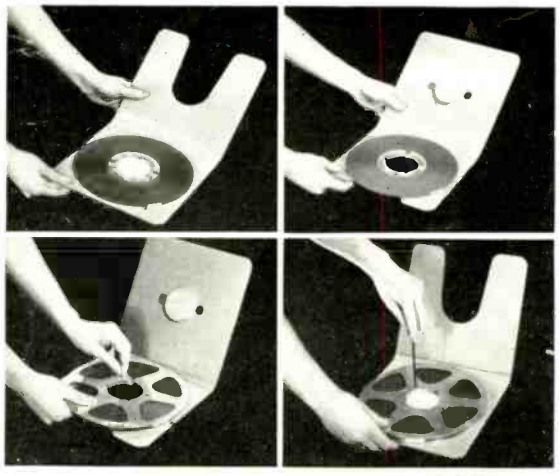
That's the real test. Audiotape actually does "speak for itself." Hear its brilliant high-frequency response—freedom from annoying background noise and distortion. There's *no friction squeal*—no rasping hum from low-frequency modulation noise. And a sensitive ear can appreciate the remarkable *uniformity* of output volume, varying not more than ±¼db for an entire 2500 foot reel.

Original recordings for phonograph records of America's leading artists are made on Audiotape. There must be a reason!



And see how Audio's
IMPROVED PACKAGING
simplifies handling and storage

All 2500 and 5000 foot rolls of Audiotape are individually boxed in specially designed containers (Pat. Pending) that make handling and storage safer and easier than ever before. Tape can be transferred from container to turntable (and vice versa) without danger of slipping from the hub or becoming unwound. Reel side flanges can be attached to hub without removing it from container. In storage, tape hangs from hub core—does not rest on edge of roll.



SEND FOR FREE
300 FOOT SAMPLE
of plastic or paper base
Audiotape today

AUDIO DEVICES, INC.
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Export Dept.: ROCKE INTERNATIONAL, 13 East 40th St., New York 16, N. Y.

*Trade Mark

Makers of
audiodiscs*
. . . the standard of disc recording quality for more than a decade

AUDIO ENGINEERING

Successor to RADIO

Established 1917

MEMBER AUDIT BUREAU OF CIRCULATIONS

C. G. McProud, Editor — **D. S. Potts, Publisher**

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E. E. Newman, Circulation Manager — H. N. Reizes, Advertising Manager

CONTENTS — OCTOBER, 1950 — Vol. 34, No. 10

COVER

Studio control console of WGN's studio 2A in the new multimillion dollar WGN Building in Chicago.

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Entered as Second Class Matter February 9, 1950 at the Post Office, Lancaster, Pa. under the Act of March 3, 1879.

LETTERS

Hearing Aid AGC

Sir:

In your June 1950 issue there appeared an instructive article by H. Hardwick on "Hearing Aid Trends." Mr. Hardwick discusses at length the types and characteristics of deafness and of hearing aids which are illustrated by *Figs.* 1 to 11. Finally, on *Fig.* 12, without any comments in the text, he gives a desirable input-output characteristic showing a 40-db volume compression over an input range of 120 db.

This is most important for the following two reasons:

> (1) With all or most deaf persons, the threshold of pain remains unchanged by the hearing loss so that amplification of loud sounds hurts them.
> (2) In certain types of nerve deafness the hearing loss is not logarithmically but arithmetically constant so that faint signals are greatly attenuated, strong ones hardly at all. Sufferers from this type of deafness need considerable volume compression in their hearing aids to avoid painful annoyance.

Compression can be applied to the instantaneous sound pressure or to the signal envelope. The latter method, although preferable, requires a combination of rectifying elements with low-pass filters of suitable time constants for attack and release.

As one who has preached volume compression in hearing aids to "deaf ears" for more than ten years, I should like to see more emphasis placed on this point. For hundreds of thousands of people it will mean all the difference between satisfactory use and rejection of hearing aids.

W. J. Albersheim, Eng. D.
Research Staff,
Bell Telephone Laboratories,
Deal, N. J.

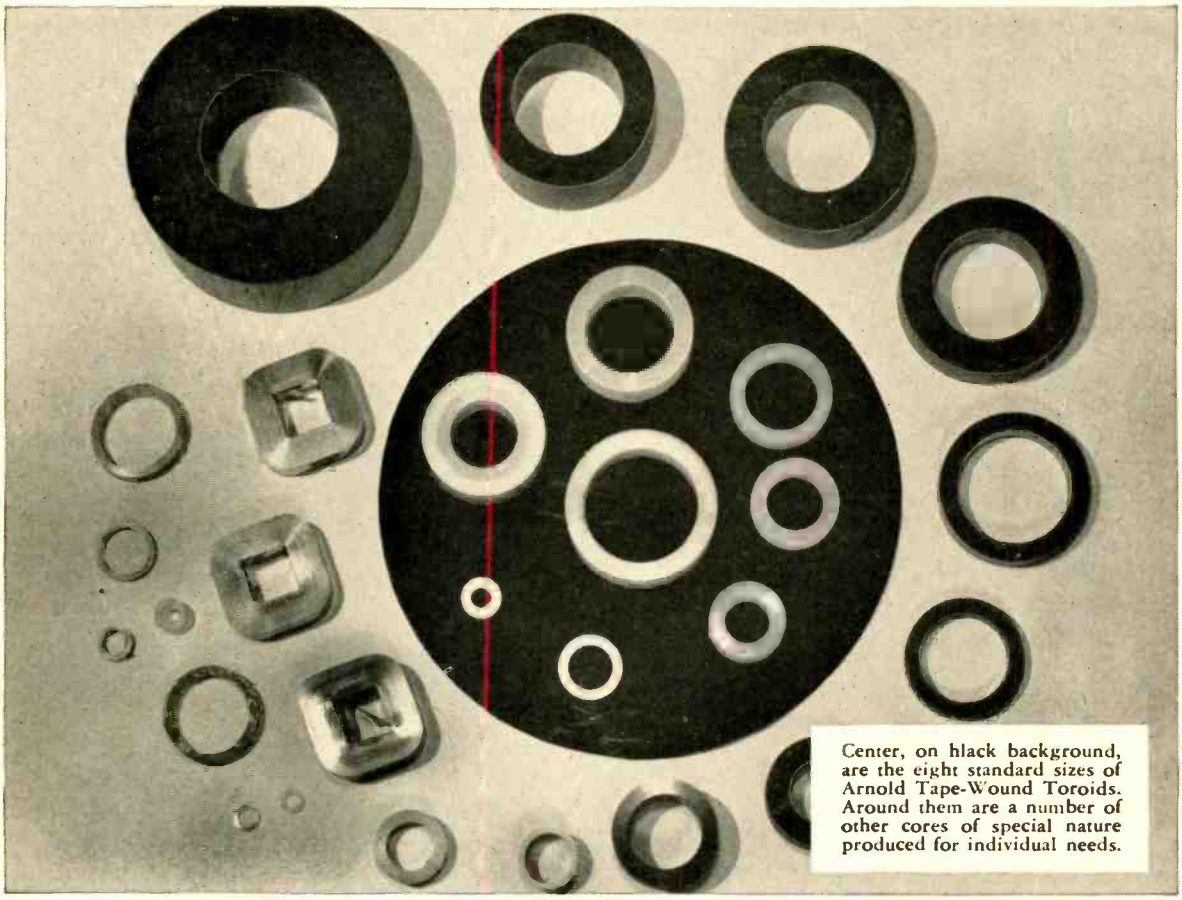
Choral Recording

Sir:

Listening to the recent Haydn Society recordings of choral works has prompted me to what I hope is constructive criticism in regard to the manner in which choral works are recorded in this country and in England, in contrast to those from continental Europe. I refer to the lack of balance between the orchestra and the chorus, with the chorus always being favored—either by the symphony conductor or by the recording engineer, or perhaps by both.

Why should the orchestra be almost completely blotted out by the overwhelming power of the voices in loud passages when the orchestra is just as important as the chorus? What is the use of an orchestra if one does not hear it, or if one hears it only sporadically when the voices are silent or sing at low level? The prominence of the orchestra should at least match the voices, and in contrapuntal works should be further emphasized because it is an integral part of the structure and just as important as the voices. Conductors and/or recording engineers should keep this in mind when making recordings of this type. It is a complete delight to listen to the Haydn Society recordings of Haydn's Missa Solemnis and Mozart's Mass in C Minor because the orchestra is right in front where it should be, and the listener does not need to strain his ear trying to follow the orchestra behind a tremendous volume of voices.

David Fonseca,
555 Notre Dame Ave.,
Chattanooga 4, Tenn.



Center, on black background, are the eight standard sizes of Arnold Tape-Wound Toroids. Around them are a number of other cores of special nature produced for individual needs.

ARNOLD TAPE-WOUND TOROIDAL CORES

of DELTAMAX 4-79 MO-PERMALLOY SUPERMALLOY*

APPLICATIONS

MAGNETIC AMPLIFIERS
PULSE TRANSFORMERS
NON-LINEAR RETARD COILS and TRANSFORMERS
PEAKING STRIPS, and many other specialized applications.

RANGE OF SIZES

Arnold Tape-Wound Toroids are available in eight sizes of standard cores—all furnished encased in molded nylon containers, and ranging in size from ½" to 2½" I.D., ¾" to 3" O.D., and ⅛" to ½" high.

RANGE OF TYPES

These standard core sizes are available in each of the three magnetic materials named, made from either .004", .002" or .001" tape, as required.

In addition to the standard toroids described at left, Arnold Tape-Wound Cores are available in special sizes manufactured to meet your requirements—toroidal, rectangular or square. Toroidal cores are supplied in protective cases.

** Manufactured under licensing arrangements with Western Electric Company.*

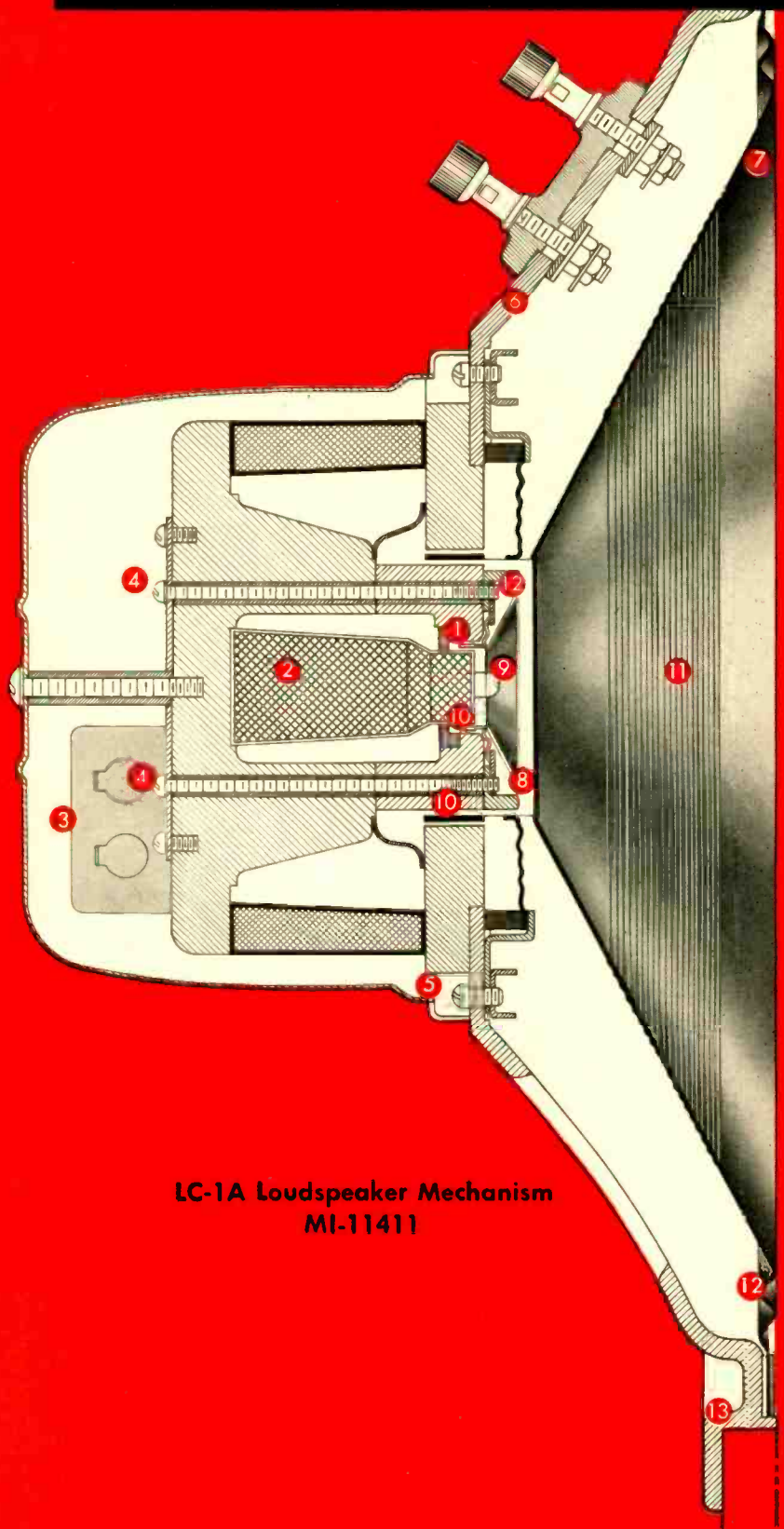
WAD 3182

THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

General Office & Plant: Marengo, Illinois

SOUND TRANSLATION.



LC-1A Loudspeaker Mechanism
MI-11411

1 H-f voice coil, aluminum wire-wound, to deliver full h-f range

2 Heavy ALNICO V magnets

3 Cross-over condenser

4 Centering adjustment for h-f cone

5 Centering adjustment for l-f cone

6 Sturdy die-cast aluminum frame

7 Shallow cone for smoath response and greater angle of distribution

8 H-f and l-f cones coaxially-mounted, mechanically indepencent

9 H-f cone. Diaphragm diameter only 2⅜". Wide-angle distribution to 15,000 cycles

10 Ample gap clearances

11 Massive 15" l-f cone. Bass response 35 to 2000 cycles at all volume levels

12 Cone rim treated to minimize edge reflections for smoother response

13 Offset mount eliminates front cavity —insures smooth response

.....next to perfect!

The Famous LC-1A Speaker

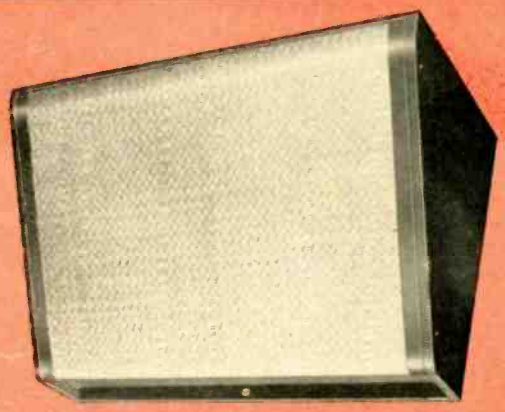
Among the great achievements of the RCA Princeton Laboratories is the development of the most advanced speaker in the world —the RCA Duo-Cone, Type LC-1A.

Expressly designed to give sound its true translation, this professional speaker is matched by no other high-quality sound reproducer.

Unique duo-cone design (originated by Dr. H. F. Olson of RCA Princeton Labs) provides a smooth response from 50 to 15,000 cycles—with no resonant peaks, harmonics, or transient distortion. Full power is radiated over 120-degrees at 15,000 cycles—makes it possible to enjoy high-fidelity sound *any place in the room!* Smooth crossover response around 2000 cycles eliminates all undesirable interference between the high-frequency unit and the low-frequency unit. Controllable "roll-off" at 5 and 10 kc... when used with the MI-11707 filter... restricts the h-f distortion and surface noises present in many recordings.

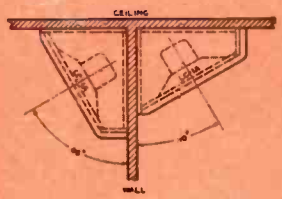
Today, more than 3000 of these speakers are serving in station control rooms, listening rooms, auditioning booths, lobbies, clients' offices, and private homes.

For more information, mail the coupon.



New Wall-Ceiling Housing for LC-1A

Ideal for sound reinforcement in control rooms, auditioning booths, hallways, talkback positions, elevators, executive offices. Port provided for increasing bass response. Finished in harmonizing 2-tone umber gray.



It's Easy to mount

The Wall-Ceiling Housing can be mounted for long or short "throws" —makes the wall and ceiling a part of the acoustical system.

The LC-1A Monitoring Speaker, with Console cabinet and MI-11707 filter

The finest reproducer in the business. Available in a choice of 2-tone umber gray or walnut finish.

RCA

AUDIO BROADCAST EQUIPMENT
RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

Department 7J,
RCA Engineering Products
Camden, N. J.

Send me price and information on

- ☐ LC-1A Speaker Mechanism, MI-11411
- ☐ LC-5A Wall-Ceiling Cabinet, MI-11406
- ☐ LC-1A Speaker with Console Cabinet, MI-11411/11401

Name_____

Station or firm_____

Address_____

City_____ State_____

TECHNICANA

Vehicle Noise

The continuing study of vehicle noise by the Armour Research Foundation in cooperation with other groups is the subject of a survey, "Levels and Spectra of Transportation Vehicle Noise," by G. L. Bonvallet, appearing in the March 1950 *Journal of the Acoustical Society of America*. This study covers transportation noises of all types throughout both residential and industrial areas, and was started before the war.

Measurement of noise and spectra levels was carried out both inside and outside of various transportation vehicles operating at their normal speeds, both during the summer and during the winter.

A series of tables and charts evaluates much of the data, and a suggestion that the objectionable quality of the noises and their loudness is more easily correlatable with the level of the 400–800 cps band than with other figures used previously, but much of the data is presented in the form of octave-band curves which the group making the study believes to be of more value than the single noise level figures based on overall level or the 400–800 cps band level. It may be seen from the curves that old subway and elevated cars have a noise level 15 to 20 db higher than new ones in the 400–800 cps band, both inside and out.

"Williamson" Amplifier Popularity

The popularity of the Williamson amplifier is attested to by the amount of space that it has been given in foreign publications. The latest to carry a full article is the Danish magazine *Radio Echo*. In a recent issue it carried an article covering circuits and construction information. A detailed discussion of the characteristics and construction practice of the transformer for the Williamson amplifier appeared in the March 1950 issue.

Home-Built Magnetic Recorder

In a complete issue devoted to audio frequency articles, the French publication *Toute la Radio* for June 1950 covers many phases of audio including articles on sound and noise, loudspeaker baffles, amplifier design, a standard frequency oscillator, and a magnetic recorder.

Of most interest to readers of Æ is the last mentioned article on an easily constructed wire recorder. Only the mechanical unit is described in this article, but the design and construction information is given, and the unit appears to be well adapted for construction in this country. It uses two motors, and a Shure W12 combination wire recording head. Among the features are a counter, mechanical braking, and the use of standard wire available in the United States.

Photography

"Photographing Sound Waves" is the title of an article appearing in the July 1950 *Bell Laboratories Record*. In order to obtain photographs of the sound field obtained with acoustic lenses and prisms, W. E. Kock and F. K. Harvey have

[*Continued on page 57*]

LOW DISTORTION SIGNAL SOURCE FOR BROADCAST MEASUREMENTS

-hp- 201B AUDIO OSCILLATOR

EASY TO USE
INEXPENSIVE
HIGH OUTPUT
LOW DISTORTION

SPECIFICATIONS

Frequency Range: 20 cps to 20,000 cps, 3 bands
X 1—20 to 200 cps
X 10—200 to 2,000 cps
X 100—2,000 to 20,000 cps

Frequency Calibration: Direct in cps for lowest band. Approximately 95 calibration points provided over 300° arc. 6" diameter illuminated dial, driven by vernier knob with 6:1 ratio. 47 inch effective scale length for 3 bands.

Stability: Better than ±2% under normal conditions (includes initial warm-up drift). No change in output frequency caused by line voltage variations as high as ±10 volts. Each band has adjustments to standardize calibration against a known frequency. With standardization, accuracy better than ±1%.

Output: Rated maximum 3 watts or 42.5 volts into a 600 ohm resistive load. One terminal is at ground potential. Maximum no-load voltage is at least 50 volts.

Frequency Response: Constant within ±1 db over entire frequency range.

Distortion: Less than 1% at 3 watts output. Less than 0.5% distortion at 1 watt output (down to 50 cps). Approximately 1% distortion at 20 cps.

Hum Level: Less than 0.1% of maximum amplifier output voltage.

Volume Controls: Amplitude control adjusts amount of oscillator voltage fed to output amplifier.
Attenuator attenuates amplifier output. Approximately linear between 0 to 40 db.

Power Supply: 115 volts ±10 volts, 50/60 cps, 75 watts.

Mounting: Rack or cabinet wrinkle-grey finish. Rack mounting $5.00 extra. Size 17" long, 8½" high, 11" deep.

Price: $250.00 f.o.b. factory.

Data subject to change without notice.

Broadcast stations across the country find this high-fidelity *-hp-* 201B Audio Oscillator an ideal signal source for broadcast measurements, including new station performance data now required by the F. C. C. It meets every FM or AM requirement for speed, ease of operation, accuracy and purity of wave form. It enables you to quickly, easily and accurately make such measurements as high fidelity amplifier tests, overall station frequency response, overall station distortion, studio—transmitter line characteristics, etc.

3 WATTS OUTPUT

The *-hp-* 201B provides 3 watts of output power into a 600 ohm resistive lead, sufficient to drive almost any kind of broadcast, laboratory or production equipment. Distortion may be limited to less than 0.5% at power of 1 watt or less. Hum level and output level can be attenuated together, and hum level is held 70 db under signal level for accuracy in working with small test signals.

20 TO 20,000 CPS

The instrument has a frequency range of 20 to 20,000 cps, covered in 3 bands. Frequencies can be tuned directly or by a 6:1 vernier control. Effective scale length is about 47" and the no-parallax tuning dial has 95 calibration points occupying 300 degrees of the scale. The entire instrument is rigidly constructed for long service; sturdy, light weight and easy to handle. It is completely powered from any 115 volt ac power source.

Get complete details. See your nearest -hp- representative or write direct.

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New York, N. Y., Los Angeles, Calif.

1878

hp laboratory instruments
FOR SPEED AND ACCURACY

Book Reviews

Records, 1950 Edition, by David Hall. 556 pp. New York: Alfred A. Knopf, Inc., $5.00.

A critical listing of all domestic recordings of serious music issued since December 31, 1947, regardless of speed, together with a large listing of foreign records selected for technical and musical quality. No such book can possibly be completely up to date, but for those who have begun to assemble a record collection since the LP entered the field, this volume is indispensable. The beginner in the high-quality audio field is treated to a thorough dissertation on records and recording methods in terms which are readily understood by the layman, and written in such a manner as to give the reader a background in the entire subject so that he may know what to look for in equipment as well as in records. This section is followed by a panorama of records and recording companies over the past three years.

The records are listed alphabetically by composer, and include the various performances of each work. Following the listing, a general criticism of the selections enables the careful reader to choose the specific recording which should best satisfy his tastes. The index of performing artists is helpful in locating the works recorded by each, and while it represents a fantastic amount of work by the author in its preparation, it is well worth it in the time saved when the records of a specific artist or organization are desired.

Mr. Hall's book is definitely recommended as a volume which should be in regular use by every collector of serious recorded music.

The Radio Manual, by George E. Sterling and Robert B. Monroe. 890 pp. New York: D. Van Nostrand Company, Inc. $12.00.

This completely revised fourth edition of the old standby has been needed for some time. Since the third edition was published in 1938, the advances in radio communication have been so rapid that the book was obsolescent.

The Radio Manual is an excellent textbook for those who would start with fundamentals and cover the entire field; it commences with elementary electricity and magnetism, and covers motors and generators, batteries, electron tubes, and the many applications of radio in all fields of communication.

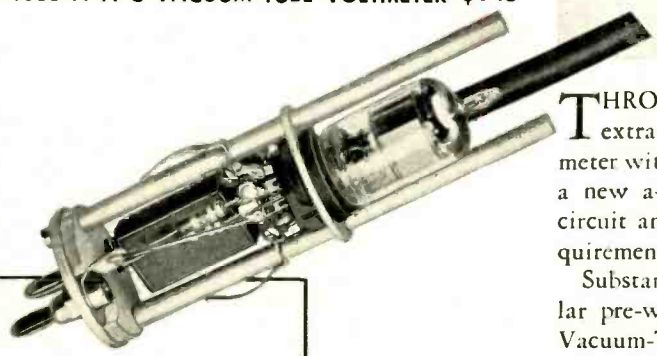
The chapters on amplitude and frequency modulation systems cover theory and give a great number of circuits for practical apparatus for transmitting and receiving and for many items of test equipment used in transmitter testing and maintenance. This material is of general educational value, and may be useful as a guide to the circuitry employed in this type of equipment. Audio engineers will find considerable useful information in the chapter on broadcast studio and control room equipment.

In this latest edition, the vast experience of Commissioner Sterling in commercial radio has been augmented by the more recent broadcast experience of CBS's Robert Monroe. The book has been brought up to date by the inclusion of chapters on marine navigational aids—such as radar and loran—and lists the complete rules and regulations of both the F.C.C. and the International Telecommunications Conference of Atlantic City 1947.

A New, MODERATELY Priced A-C VACUUM TUBE VOLTMETER

- **FIVE RANGES:** four scales cover the 5 ranges from 0.1 to 150 volts, a-c (full scale 1.5, 5, 15, 150, and 150 volts)
- **ACCURATE:** ± 3% of full-scale on all ranges; r-m-s values of sine-wave voltage
- **FREQUENCY RANGE:** without correction, up to 120 Mc with maximum error of 10%; correction curve supplied
- **INPUT IMPEDANCE:** equivalent input capacitance of probe is 11.5 $\mu\mu$f; with plug connectors 12 $\mu\mu$f; equivalent parallel input resistance 7.7 megohms at low frequencies
- **SINGLE ZERO ADJUSTMENT:** for all ranges
- **INTERNAL CALIBRATION CONTROL:** single adjustable resistor corrects calibration if amplifier tube is changed
- **AUXILIARY CONNECTORS:** G-R double plug, pair of 30-inch test leads, pair of test prods and two alligator clips supplied as convenient accessories
- **SMALL — LIGHT WEIGHT:** only 9¼ pounds

TYPE 1803-A A-C VACUUM-TUBE VOLTMETER $145



Probe with completely shielded case removed. Twin diode tube in the probe has an inactive section connected to the grid of one triode in the V-2 amplifier while the active section is connected to the grid of the other triode, both sections of the amplifier being used in a balanced circuit. The balanced amplifier insures very little zero shift when the line voltage varies.

THROUGH the elimination of many unnecessary frills and extra circuit refinements which would be necessary in a meter with ohmeter and d-c circuits and scales, G-R announces a new a-c vacuum-tube voltmeter with a straightforward circuit and with accuracies sufficient for most laboratory requirements, at a very moderate price.

Substantially duplicating the performance of the very popular pre-war Type 726-A instrument, the new Type 1803-A Vacuum-Tube Voltmeter sells for less than its predecessor and is improved over the older model in that it is smaller, lighter, has a probe which is smaller and completely shielded, a single zero adjustment for all ranges and a power supply not limited to operation at a single frequency.

The probe plugs into clips on the side of the cabinet, in which position the auxiliary test leads and terminals supplied with the instrument can be attached conveniently to the input connections.

This instrument should find wide application in many laboratories operating on a modest budget. Its accuracy is sufficient for the majority of laboratory measurements.

WRITE FOR COMPLETE DATA

GENERAL RADIO COMPANY Cambridge 39, Massachusetts

90 West St., New York 6 920 S. Michigan Ave., Chicago 5 1000 N. Seward St., Los Angeles 38

EDITOR'S REPORT

THE AUDIO FAIR

FOR THE SECOND TIME, the halls of Hotel New Yorker will be filled with a milling throng for three days this month—with rooms on both the fifth and sixth floors being given over to the displays of the manufacturers and jobbers of everything in the audio field. Ranging from complete speech input systems for broadcast and recording studios to the smallest transformers used in audio, and with tape and disc recorders, high-quality radio tuners, speaker cabinets, amplifiers, pick-ups, attenuators, and many other devices and components, The Audio Fair 1950 is certain to be more entertaining and interesting than was the first one.

Not to be overlooked are the five technical sessions of the second annual convention of the Audio Engineering Society, with over twenty papers covering all branches of audio. As before, a small charge will be made to non-members for attendance at these sessions, but by applying for membership in the Society at the time of registration, this charge may be avoided.

The growth of the Society over the past two years is strong indication of greatly increasing interest in audio. Starting with a group of twenty members in 1948, the Society now numbers over 1000 in its membership, with sections in most principal cities of the country.

SCARE BUYING

The current world situation has already been reflected in shortages of many items of electronic equipment in a fashion which is somewhat reminiscent of the early 40's, and which is either a monument to business acumen and enterprise or a sad commentary on human nature.

Granted that production of electronic equipment is greatly accelerated because of military requirements, and granted further that each manufacturer must make sure that his supply lines are functioning properly, there is no excuse for unwarranted hoarding of components. The maintenance of reasonable inventories of component parts is desirable from any viewpoint, but if deliveries are being made in a specified length of time and have some promise of continuing at the same rate, intelligent buying warrants inventories only adequate to take care of the delivery period.

Resistor deliveries from manufacturers have recently been quoted at thirty-five weeks, but this delay has been of so long a standing that it is presumed that most of this particular shortage may be attributed to television. Certain of the 12-volt series of tubes—12AT6, 12AU7, and 12AX7 in particular—have been unobtainable for several weeks, and 5U4G's are scarce.

We are firmly in favor of keeping a reasonable number of spare tubes on hand—even for home or small public address installations. The FCC Standards of Good Engineering Practice call for the stocking of a spare tube of every type employed in transmitters and in frequency and modulation monitors, with the proviso that when one or two tubes of a given type are employed, it is necessary to carry only one spare; for 3 to 5 tubes of a type, 2 spares are necessary; for 6 to 8 tubes of a type, 3 spares; and for over 9 tubes of a type, 4 spares shall be kept on hand. This is a good policy for any user of tubes, and need not be expanded to require the stocking of a spare tube for every socket as is the practice in some quarters.

As far as tubes are concerned, this number of spares should not necessarily tighten up the supply appreciably, but would give everyone an opportunity to be adequately protected in case of failures—such as have been experienced by practically everyone late on a Saturday night. As to other components, circumstances may alter the size of the inventory which seems desirable, but it is hoped that users may overhaul their methods so that complete draining of supply lines will not be effected.

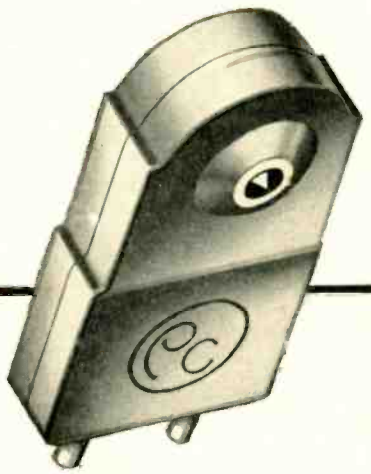
THE CATHAMPLIFIER

From Australia we have recently received a booklet describing the Parry Cathamplifier—a new type of push-pull audio-frequency amplifier system. This unit is claimed to give high-quality performance with a minimum of components, and from the circuits shown it is apparent that relatively few components are employed.

Basically, this circuit consists of a single voltage amplifier pentode followed by push-pull output pentodes or tetrodes, the phase inversion being provided by a self balancing arrangement comprising a transformer with its primary connected to the two cathodes of the output tubes and the secondary exciting the grid of the phase-inverting stage. Circuits are shown for amplifiers of 8, 15, and 40 watt outputs. After a reasonable amount of investigation has been made of the potentialities of this unit, it will be further described in these pages.

TECHNICANA RETURNS

The long absent section covering interesting developments in the audio field as described in foreign and some specialized U.S. publications will be welcomed by many who have suggested that it be resumed. While the space devoted to such material may be too limited for complete descriptions of the subjects, it will at least serve to direct the attention of the reader to the originating publication for further information. This column will be scheduled for alternate months.



PICKERING PICKUP CARTRIDGES FOR THE FINEST AUDIO QUALITY

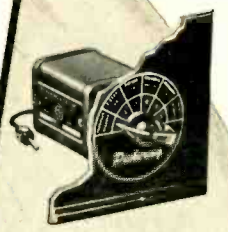
No other Pickup will reproduce LP records with the fidelity of Pickering Cartridges . . . they are the most widely used by record manufacturers, recording studios, broadcasters and music enthusiasts who demand the effect of a live performance from their records.

The nearest approach to a live performance is a recording played by a system equipped with Pickering High Fidelity Audio Components . . . Speaker, Cartridge, Arm, Preamplifier, Record Compensator, etc.

Pickering Cartridges Series 120 and 150 are for standard records . . . Series 140 are for microgroove records . . . They track with phenamenally low record wear and virtually eliminate harmonic and intermodulation distortion as well as frequency discrimination . . . all Pickering Cartridges available with either sapphire ar diamond stylus.

LOUDSPEAKER MODEL 180L

Designed to satisfy the musical ear. A low-cost high quality loudspeaker with smooth wide-range response (within 5 db, 45 to 12000 cycles) and low distortion . . . the only loudspeaker with acoustically adjustable bass response . . . occupies less floor space than any other high quality loudspeaker — less than one square foot.



RECORD COMPENSATOR MODEL 132E

This compensator, with 6 positions of equalization, provides the flexibility required to properly equalize for the different recording characteristics used by various record manufacturers . . . it is a most important addition to record playing systems using magnetic pickups.

PREAMPLIFIER MODEL 130H

This preamplifier represents the most advanced design ever achieved in phonograph preamplifiers . . . it equalizes the bass response of records and transcriptions and provides the necessary gain for high quality magnetic pickups . . . its intermodulation and harmonic distortion is exceptionally low — better than most professional equipment.

PICKUP ARM — MODEL 190

The only arm specifically designed for optimum performance on both microgroove and standard records.

- Statically balanced to eliminate tendency to skip when jarred.
- Minimum vertical mass to track any record without imposing extra vertical load on grooves.
- Sensitive tracking force adjustment.
- Magnetic arm rest.
- Rugged frictionless bearings.
- Plug-in cartridge halder.
- One-hole mounting — self-contained levelling screws.

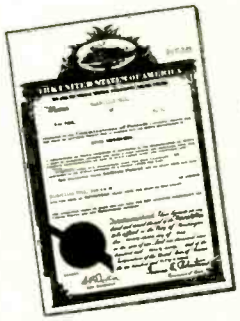
Cartridges used with this arm require 50% less vertical tracking force than when used in conventional arms.

Pickering & Company, Inc.

Oceanside, N. Y.

For the finest audio quality specify Pickering Components

Pickering High Fidelity Components are available through leading jobbers and distributors everywhere . . . detailed literature will be sent upan request.



AUDIO PATENTS

RICHARD H. DORF*

It is very doubtful that there breathes anywhere a recording engineer who has not at one time or another spoken some very bad words in description of conventional volume indicators when they failed to indicate a large instantaneous peak and thus allowed the system to over-modulate and ruin a recording. Two things prevent decibel and VU meters from indicating the true amplitude of peaks—mechanical inertia and the fact that they operate from half-wave-rectified audio, thus being subjected in the first place only to either negative or positive peaks, but not both. John F. Clark has taken the lowly neon lamp, ordinarily used for volume indication only in nonprofessional equipment, and made a useful and precise instrument. The patent is numbered 2,494,643, and is assigned to RCA.

Two tricks make all the difference. First, not one but several lamps are used, each set to light at a different level. Thirteen of them, for example, might be arranged on a small panel, and as sound level rises, they would begin to light, starting with the one on the left; the rightmost lamp lighted would show the actual instantaneous level—instantaneous because the system is entirely electronic, thus inertialess. Such an arrangement was used in early RCA Photophone film recording channels.

Figure 1 shows the schematic, with the usual amplifying equipment being employed for the recording circuits. A bridging transformer T_1 taps off some of the audio and feeds it to a two-tube preliminary amplifier V_1 and V_2. Across the output of V_2 is a voltage divider with several taps. The full voltage goes through a pair of amplifier stages V_3 and V_4 to a triode, the plate circuit of which contains the –45-db neon lamp. Thus, low-level signals will make that lamp light.

Lower taps on the divider go through amplifiers of progressively less gain as required to make succeeding lamps (up to the –6-db unit) light at the audio levels indicated.

As we get closer to zero or reference level, peaks become more important, since they may cause overmodulation. So far, the lamps have been driven by what is effectively a half-wave rectifying arrangement—the tube plate circuits. In speech and music, however, peaks may occur at random on either negative or positive side of the a.c. baseline; an indicator system driven by one of these will not read peaks on the other.

The answer is the full-wave bridge rectifier in *Fig. 1*. It is driven by V_1 and V_2 and

[*Continued on page 65*]

* *Audio and Television Consultant, New York.*

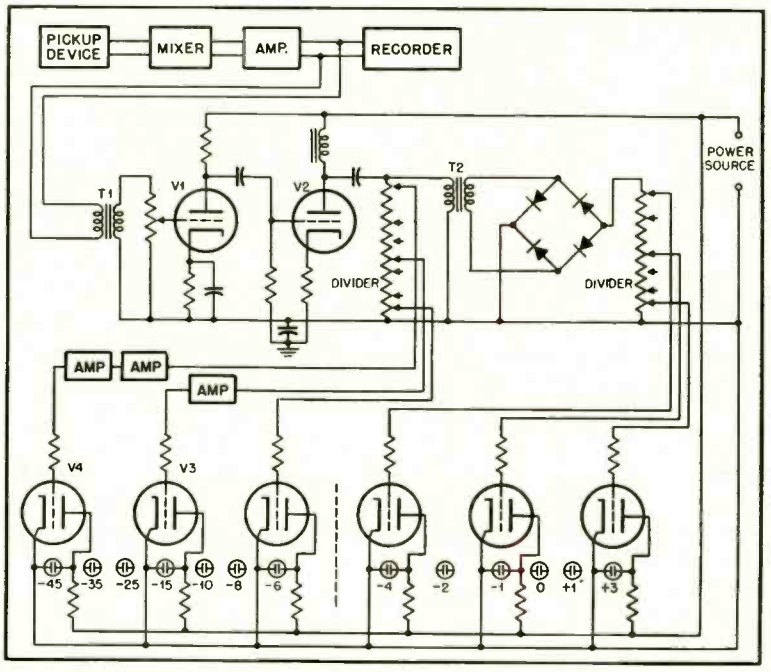


Fig. 1.

Intermodulation can be measured quickly and accurately with MEASUREMENTS' new, portable MODEL 31 INTERMODULATION METER

COMPLETELY SELF-CONTAINED

- TEST SIGNAL GENERATOR
- ANALYZER
- VOLTMETER
- POWER SUPPLY

To insure peak performance from all audio systems; for correct adjustment and maintenance of AM and FM receivers and transmitters; checking linearity of film and disc recordings and reproductions; checking phonograph pickups and recording styli; checking record matrices; adjusting bias in tape recordings, etc.

MEASUREMENTS CORPORATION meets the demand for compact, easily-operated intermodulation equipment! The MODEL 31 is moderately priced, yet extremely accurate and built to the same rigid specifications of all "LABORATORY STANDARDS".

One section of the MODEL 31 supplies mixed audio frequencies to the apparatus under test; the resultant signal from the apparatus is then applied to the analyzer section of the MODEL 31 to be filtered, amplified, demodulated and metered. The meter is direct-reading in percentage of intermodulation and input volts.

Specifications:

GENERATOR

LOW FREQUENCY: 60 cycles.
HIGH FREQUENCY: 3000 cycles.
LF/HF VOLTAGE RATIO: Fixed 4/1.
OUTPUT VOLTAGE: 10 v. max. into high impedance or +5 DBM matched to 600 ohms.
OUTPUT IMPEDANCE: 2000 ohms.
RESIDUAL INTERMODULATION: 0.2% max.

ANALYZER

INPUT VOLTAGE: Full scale ranges of 3, 10 and 30 volts RMS. Less than one volt of mixed signal is sufficient for operation.
INPUT IMPEDANCE: Greater than 400 K ohms.
INTERMODULATION: Full scale ranges of 3, 10 and 30%.
ACCURACY: ±10% of full scale.
OSCILLOSCOPE connection at meter.

Power supply: 117 volts, 50/60 cycles, 30 watts. Dimensions: 8" high x 19" wide x 9" deep. May be mounted in standard 7" relay rack panel space. Weight: 16 lbs.

MODEL 30 INTERMODULATION METER

This model has a test generator providing, a low frequency range of 40, 70 and 100 cycles, a high frequency range of 2000, 7000 and 12,000 cycles, either separate or mixed in a 1/1 or 4/1 ratio.

The analyzer will operate from 20 cycles to 200 cycles and from 2000 cycles to 20,000 cycles.

A direct-reading meter measures intermodulation percentages from 0.1% to 30%; test generator output voltages from .01 to 100 v. (−30 to +20 DBM); analyzer input voltages from .0001 to 100 v. (−70 to +40 DBM).

Detailed circular on request

MEASUREMENTS CORPORATION
BOONTON NEW JERSEY

Saving energy for better low-cost telephone service

Arrow points to tube containing a wire specimen under test for surface conductivity. The tube and wire are excited to resonance by microwaves from generator at extreme left. Conductivity is calculated from frequency values indicated by barrel-shaped wavemeter (top center) and resonance curves traced on an oscilloscope screen (not shown).

In the waveguides which conduct microwaves to and from the antennas of radio relay systems, current is concentrated in a surface layer less than 1/10,000 inch thick, on the inner surface of the waveguide. When these surfaces conduct poorly, energy is lost.

To investigate, Bell radio scientists devised exact methods to explore this skin effect at microwave frequencies.

Scratches and corrosion, they found, increase losses by 50 per cent or more. Even silver plating, smooth to the eye, can more than double the losses of a polished metal. Very smooth conductors, like electropolished copper, are best. An inexpensive coat of clear lacquer preserves initial high conductivity for many months.

Energy saved *inside* a microwave station is available for use in the radio-relay path *outside*. So stations can sometimes be spaced farther apart, and there will always be more of a margin against fading. Here is another example of the practical value of research at Bell Telephone Laboratories.

BELL TELEPHONE LABORATORIES

WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE BIG IN VALUE AND LOW IN COST

Sensitivity, Directivity and Linearity of Direct Radiator Loudspeakers

HARRY F. OLSON*

In which the author shows that it is not desirable to obtain high sensitivity at the expense of smooth response, low distortion, and uniform directivity.

THE SENSITIVITY, DIRECTIVITY AND LINEARITY are interdependent in any direct-radiator dynamic loudspeaker. During the past decade, considerable emphasis has been placed upon high sensitivity with little regard for the factors of directivity and distortion. The reason for this state of affairs is that high sensitivity in a loudspeaker is easily demonstrated and more dramatic than the degradation of quality due to distortion and sharp directivity. As a consequence, smooth response, broad directivity, and low distortion have been sacrificed for sensitivity. For example, a loudspeaker with a high order of distortion and a narrow directivity pattern will sound louder than one with low distortion and a broad directivity pattern. However, a careful consideration will show that a more uniform directivity coupled with lower distortion at the sacrifice of sensitivity will lead to a superior loudspeaker. In order to make the analysis somewhat simpler, the considerations in this paper will be confined to single-element loudspeakers. However, the same conclusions will hold for multiple-unit systems.

* RCA Laboratories, Princeton, N. J.

[1] Olson, Elements of Acoustical Engineering, D. Van Nostrand Company, N. Y., 1947, p. 124.

Sensitivity

The efficiency[1], in per cent, of a direct-radiator dynamic loudspeaker is given by

$$\mu = \frac{(Bl)^2 r_{MA} \times 100}{(Bl)^2 (r_{MS} + r_{MA}) + r_{EC} \times [(r_{MC} + r_{MA})^2 + (x_{MA} + x_{MC} - x_{MS})^2]} \qquad (1)$$

where B = flux density in the air gap, in gausses,

l = length of the voice coil conductor, in centimeters,

r_{EC} = electrical resistance of the voice coil, in abohms,

r_{MA} = mechanical resistance of the air load upon the cone, in mechanical ohms,

x_{MA} = mechanical reactance of the air load upon the cone, in mechanical ohms, and

r_{MS} = mechanical resistance of the suspension system, in mechanical ohms,

x_{MC} = mechanical reactance of the mass of the cone and voice coil, in mechanical ohms,

$= j\omega m_c$

m_c = mass of the cone and voice coil, in grams,

X_{MS} = mechanical reactance of the suspension system, in mechanical ohms,

$= \frac{1}{j\omega C_M}$,

C_M = compliance of the suspension, in centimeters per dyne.

For a particular diameter of the cone, r_{MA} and x_{MA} are fixed. For a fixed weight of magnet material and air gap, the flux density in the air gap is fixed. The air gap establishes the dimensions and mass of the voice coil. The remaining variable is the mass of the cone and the compliance and mechanical resistance of the suspension system.

From the above equations, it will be seen that the efficiency or sensitivity of a direct-radiator dynamic loudspeaker can be increased by reducing the mass of the cone.

The response-frequency characteristic of a typical commercial five-inch high sensitivity dynamic direct-radiator loudspeaker, designated as *A*, is shown in *Fig.* 1. It will be seen that the response at the low-frequency resonant peak is

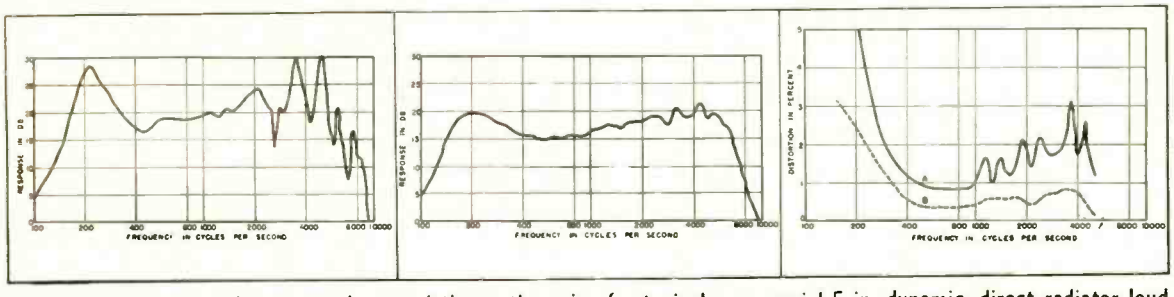


Fig. 1 (left). Response-frequency characteristic on the axis of a typical commercial 5-in. dynamic, direct-radiator loudspeaker, designated as (A). Fig. 2 (center). Response-frequency characteristic on the axis of a 5-in. loudspeaker with all the parameters the same as those of (A) except that the cone mass is two times that of (A) and the mechanical resistance of the suspension system larger that that of (A). Fig. 3 (right). Total harmonic distortion-frequency characteristics of loudspeakers (A) and (B). Power input to (A) is 0.2 watts; to (B), 0.4 watts.

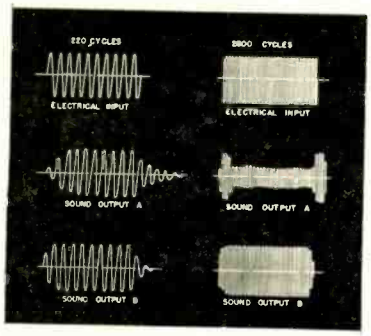


Fig. 4. Tone burst response of loudspeakers (A) and (B) at 220 and 2800 cps.

very high. In addition, the response-frequency characteristic is ragged in the high-frequency range. Both of these characteristics conspire to make the loudspeaker sound louder.

The response-frequency characteristic of a five-inch loudspeaker, designated as *B*, with the same magnet structure and voice coil as loudspeaker *A* in the preceding example, but with a cone of two times the mass, and a suspension system with higher mechanical resistance is shown in *Fig.* 2. It will be seen that the general sensitivity is considerably lower than that of *Fig.* 1. The lower sensitivity comes about by reason of the larger cone mass. The effect of the larger mass of the vibrating system can be deduced from equation (*1*). The response-frequency characteristic of loudspeaker *B* shown in *Fig.* 2 is smooth. The smooth response is due to the greater stiffness and damping in the heavier cone of loudspeaker *B*. The stiffness is increased approximately eight times by doubling the mass, which in turn doubles the thickness. An increase in the stiffness of the cone reduces the "break-up" effects in the cone. These break-up effects lead to a nonuniform response-frequency characteristic. The response in the low-frequency region is not as accentuated in loudspeaker *B* as in loudspeaker *A*. The response at the resonant frequency of loudspeaker *B* is reduced by a larger mechanical resistance in the suspension system.

Listening tests indicated that the sensitivity of loudspeaker *A* was about 3 db higher than *B*, which agrees with the response measurements of *Figs.* 1 and 2. Most loudspeakers today are evaluated by comparing response-frequency characteristics taken on the axis, or by means of listening tests in which the observation points are on or near the axis. In comparison of performance, sensitivity appears to be the principal consideration. However, careful listening tests will show that the distortion produced by loudspeaker *A* is very high as compared to loudspeaker *B*. The distortion characteristics of these two loudspeakers will be examined in the next section.

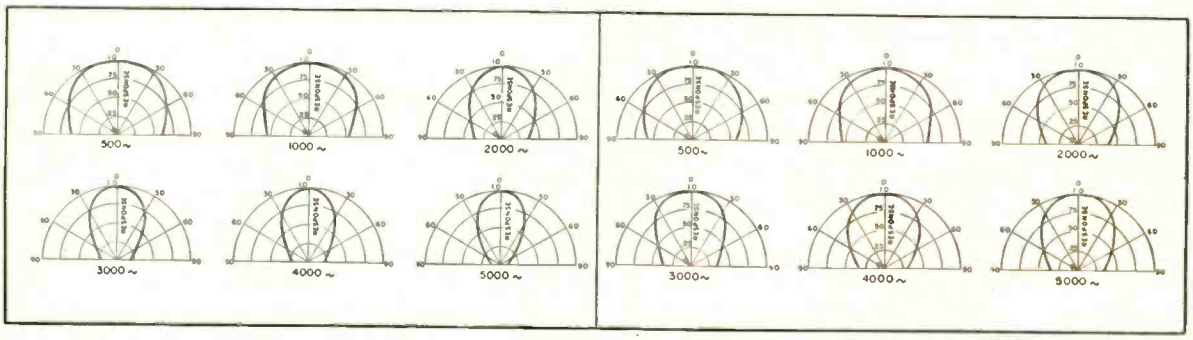


Fig. 5 (left). Directional characteristics of a typical commercial 12-in. dynamic direct-radiator, designated as (C). Fig. 6 (right). Directional characteristics of a 12-in. direct-radiator loudspeaker with a broad angle and processed cone. designated as (D).

Distortion

One of the effects of nonlinearity in the elements of the vibrating system of a loudspeaker is the production of harmonics and subharmonics. Nonlinearity in a cone occurs when the force vs. displacement characteristic deviates from a straight line. In a light-weight cone, this deviation occurs at a relatively small input.

The total nonlinear distortion frequency characteristic of loudspeaker *A* for an input of 0.2 watts is shown in *Fig.* 3. The total harmonic distortion-frequency characteristic of loudspeaker *B* for an input of 0.4 watts is also shown in *Fig.* 3. Note that the power input of *B* is doubled to compensate for the decreased sensitivity. Under these conditions, the sound output of the two loudspeakers will be the same. It will be seen that the harmonic distortion of loudspeaker *B* is very much less than *A*. This is to be expected, because the rigidity of the cone of *B* is at least eight times that of *A*.

Since all speech and music is of a transient character, the transient response is another characteristic which depicts the performance of a loudspeaker. Poor transient response leads to fuzzy reproduction with poor definition. As a result, the character of speech or musical instruments is destroyed.

A deviation in the sound output of a loudspeaker from the rapid growth and decay characteristics and the uniform steady state characteristics of an applied electrical tone burst depicts the transient response of the loudspeaker.

The responses of loudspeakers *A* and *B* to tone bursts at the resonant frequency of 220 cps are shown in *Fig.* 4. It will be seen that the transient response of loudspeaker *A* is superior to loudspeaker *B*, because the growth and decay are much faster. The responses of loudspeakers *A* and *B* to tone bursts at 2800 cps are also shown in *Fig.* 4. The transient response of loudspeaker *A* is poor. In general, a ragged response frequency characteristic, such as that exhibited by loudspeaker *A* (*Fig.* 1), indicates that it will exhibit poor transient response. The tone bursts of *Fig.* 4 demonstrate that the transient response of a loudspeaker with a nonuniform response-frequency characteristic will exhibit poor transient response.

Directivity

The directional characteristic of a loudspeaker is the response as a function of the angle with respect to some

reference axis of the system. The directional patterns are usually depicted in polar coordinates. The directivity of a piston-type radiator, such as a cone, becomes sharper as the ratio of the diameter to the wavelength increases. However, the directivity pattern can be controlled to a degree by the shape and the material of the cone.[2] If the directivity varies with frequency, frequency discrimination will result for points removed from the axis. In most loudspeakers, the high-frequency response is radiated in a narrow beam. Under these conditions, the high-frequency response is materially reduced when the observation point is a few degrees off the axis. Since a sharp directivity pattern is generally undesirable, the only reason for the existence of a loudspeaker with a sharp directivity pattern is to obtain high sensitivity on the axis. This will now be illustrated.

The directional characteristics of a typical commercial, twelve-inch, dynamic, direct-radiator loudspeaker, designated as *C*, are shown in *Fig.* 5. The directional characteristics of a twelve-inch dynamic, direct-radiator loudspeaker, with a broad directivity pattern, designated as *D*, is shown in *Fig.* 6. The open angle of the cone of loudspeaker *D* is wider than that of loudspeaker *C*. In addition, the cone is processed to reduce the velocity of sound propagation. These expedients conspire to yield a broader directivity pattern. It is quite obvious that the directivity pattern of loudspeaker *D* is far superior to that of *C*, because the frequency discrimination for points removed from the axis is far less severe than that of loudspeaker *C*.

The response-frequency characteristics of loudspeakers *C* and *D* are shown in *Figs.* 7 and 8. Since there is about the same amount of energy emitted by both loudspeakers, the loudspeaker with the sharper directivity will, of course, exhibit the highest response on the axis in the high-frequency region. However, for points removed from the axis, loudspeaker *D* will be superior. Unfortunately, both response and listening tests are usually made on the axis. Under these conditions, the loudspeaker with the highest response usually wins, even though from an over-all standpoint it is inferior.

[2] Olson, "Elements of Acoustical Engineering." New York: D. Van Nostrand Company, 1947, p. 47.

Power Requirements

For home and other small-room sound reproduction, high sensitivity is not a requirement because the power available from the amplifier is more than adequate to obtain satisfactory sound levels. For example, the loudspeaker *B* of this paper will deliver a sound level of 80 db in the average living room for an input of .05 watt. Most amplifiers used in radio receivers and phonographs are of the order of 2 to 10 watts. In the case of loudspeaker *A*, the distortion is so high for inputs over 0.2 watts that the reproduction is not tolerable beyond this level, whereas loudspeaker *B* will handle much more power with tolerable distortion. In other words, the loudspeaker with the heavier cone and lower sensitivity used with conventional amplifiers will actually deliver more sound power before it overloads. Therefore, smooth response, low distortion, and a broad directivity pattern are more desirable than high sensitivity, because high sensitivity is of no practical value if it is obtained at the expense of low distortion and a broad directivity pattern.

Conclusion

The analysis in this paper has established that nonlinear distortion can be reduced and the response frequency characteristic smoothened by increasing the rigidity of the cone in a direct-radiator loudspeaker. Increased inherent stiffness of the cone can be obtained by the use of a thicker cone, which in turn means a more massive vibrating system. A more massive vibrating system reduces the sensitivity. In this connection, it may be mentioned in passing there is nothing profound about the sensitivity of a direct-radiator loudspeaker. Greater sensitivity can be obtained either by a larger magnet or a lighter vibrating system. If the magnet size is the same in two loudspeakers, the one with the lightest vibrating system will show the greatest sensitivity. On the other hand, the power output for the same distortion is many times greater for the loudspeaker with the more massive vibrating system. In addition, the response-frequency characteristic is much smoother and the transient response is improved when a heavier cone is used. Therefore, when loudspeakers are compared in listening tests, the sound outputs should be adjusted to the same level before a comparison is made, because sensitivity is of secondary importance.

The analysis in this paper has also shown that a uniform directivity pattern with respect to frequency is more desirable than a directivity pattern which becomes sharper with increase in the frequency. The latter type of directivity produces frequency discrimination for observation points removed from the axis. For loudspeakers with well designed vibrating systems of the same mass and area and the same magnetic structure, the total sound output of the loudspeakers will be the same. Therefore, if the angular spread of the sound radiation is increased, the sound intensity on the axis will be reduced. In other words, the loudspeaker with the broader directivity pattern will appear to be less sensitive when the observation point is on the axis. Therefore, the directivity pattern is another factor that should be carefully checked by measurements or listening tests.

To summarize, this paper has shown that it is undesirable to obtain high sensitivity in a loudspeaker by sacrificing uniform response, good transient response, low nonlinear distortion, and uniform directivity.

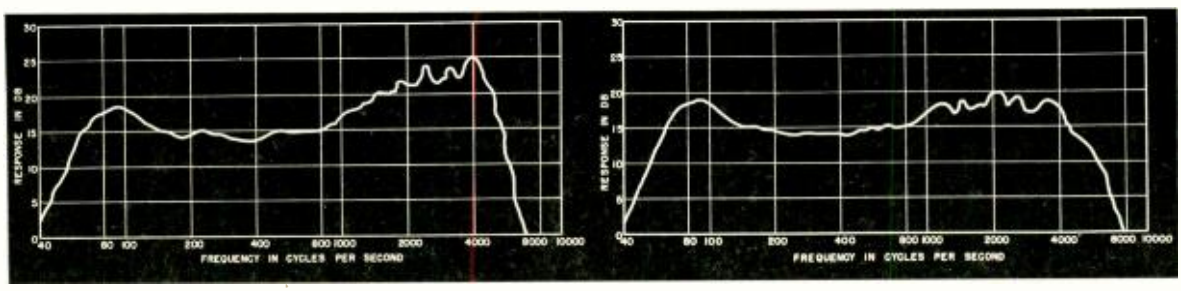


Fig. 7 (left). Response-frequency characteristic on the axis of the loudspeaker designated as (C). Fig. 8 (right). Response-frequency characteristics on the axis of the loudspeaker designated as (D).

Remote Installations

ELLIOT D. FULL*

One broadcaster's solution to the need for remote studio facilities with a maximum of operability and a minimum of cost.

A SMALL OR MEDIUM-SIZED unaffiliated broadcast station has one big advantage over larger network stations—it can program to its own trade area. If this advantage is exploited to its utmost a small station can more than hold its own against the talent, programming, and national advertising accounts of network stations. To compete effectively, small stations need to use varied live studio shows and a great number of remotes.

At KXIC this problem has taxed the ingenuity and ability of everyone in the engineering department. Here is a list indicating the variety of remotes we have done:

- Everyday program from farm editor's home
- Weekday programs from small studio in nearby town
- Short wave program while driving in a parade
- Man-on-the-Street on Saturday
- "Country Editor" from another small town
- Beep recorded news from still another town
- Short wave show from new swimming pool
- Community Building Teen-Club Saturday (with public address system for dancing)
- Two church remotes every Sunday
- A home talent show from a local theater Saturday mornings

We have built most of the specialized remote equipment ourselves partly for economy reasons but mostly because of special design problems peculiar to the individual remote involved.

The amplifier for the Teen-Club has two microphone channels, a phonograph channel and a bridging public address system. The P.A. has two gain controls which are alternately switched in and out as the main microphone channel is switched. The P.A. gain controls can be pre-set to allow for a reduction in P.A. volume as the microphone is switched on. The system has performed excellently. It has been completely described elsewhere.*

The first two named remote systems involve ideas, both in programming and engineering, that have helped us to integrate the station more completely into the trade area.

Broadcast from Farm Editor's Home

The owners and our popular farm editor, G. M. Ludwig, decided that he ought to do an early morning broadcast from his home. The engineering department was simply requested to "hook it up."

Upon investigation we found that Ludwig lived a half mile from a small town that has a telephone "switchboard" designed by Martha Washington or one of her contemporaries. The patch cords were all frayed, the key switches on their last legs, and the repeat coils about through repeating. Worst of all, the operator was not on duty before six in the morning. In addition to all this our farm man was twelfth and last man on the end of a ground-return country party line. We honestly felt that 10 watts of audio would not have overridden the "line" noise and the attenuation due to the other parties "rubbering" (listening-with low impedance earphones).

Since the party line curved around the countryside with Ludwig actually being fairly close to town, we decided to string an open-wire pair to the edge of town and to run a twisted pair on the local company poles from there to the exchange. When this job was done we repaired a drop that hadn't worked for years and connected in.

As can be seen from the *Fig.* 1, when the remote amplifier is turned on, Ludwig's phone is disconnected, the amplifier's output is connected to the line and about 50 volts simplexed onto the line. This potential operates a simplexed relay at the phone exchange which "lifts" his line off the local exchange and connects him through to a larger nearby city which has full time operators and better equipment. Here a switch is thrown and connection made with Iowa City.

The amplifier is of conventional design and, for obvious reasons, of only medium fidelity. A reasonably good dynamic microphone is used. No volume indicator is provided. Cue is sent back from the station and picked up by Ludwig on earphones which he promptly discards as soon as the broadcast gets under way. Suffice to say, these early morning broadcasts have a large rural audience and have obtained amazing results for the sponsors.

Remote Studio Console

The small console shown in *Fig.* 2 is used in a town of about 5,000 some thirty miles south of Iowa City. This town Washington, Iowa had shown considerable interest in radio for quite a while. Since it is too small for the profitable operation of a commercial radio station we decided to put in a small studio and control room. This venture involved an element of risk, so a minimum-cost installation was thought desirable. The studio dimensions were

*Chief Engineer, KXIC, Iowa City, Ia.

* *Communications*, October, 1949.

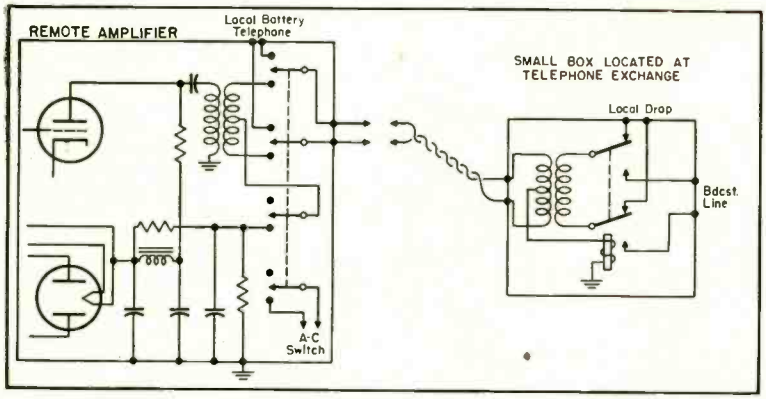


Fig. 1. Arrangement for remote amplifier so that telephone central office equipment is switched as required when amplifier is energized.

designed around the cube root of two as far as possible and a reverberation time in the studio of about 0.8 seconds was planned. Because of heavy floor traffic in the store above, a totally isolated ceiling was included. The double walls were lined inside with acoustical block and polycylindrical surfaces.

The console had to be very simple from the operation standpoint and yet it had to control (1) an "A" mike, (2) a control-room mike, (3) an on-the-street mike, (4) a turntable. In addition, it had to allow for receiving cue from the control room in Iowa City on the speakers, and to cut each speaker when its associated mike was live. We also provided a 10-watt bridging amplifier for speakers in the lobby, in the store above, and one we hope to install in the town square. The on-the-street and "A" mike outlets are paralleled. When Mangold does a man-on-the-street program, he removes the "A" mike, turns on the "A" channel, and sets its gain slightly lower than normal. On the street he plugs his mike into the outlet located on the front of the store, and plugs a pair of earphones into a jack which is connected across the Iowa City line. This arrangement eliminates the need for a control board operator.

Fig. 2. Small studio console made up for use in one of the remote installations.

Switching relays were unnecessary since the mikes and the turntable were switched as seen in *Fig.* 3 at the output of their preamplifiers, a level of −40 db. The studio and control speakers were controlled by the same switches since the speaker level would rarely exceed zero db.

As a result of these simplifications, the console panel contained only three switches, one meter and three mixer controls. The small associated relay rack contains only a monitor control, a program control, a booster standby switch, and an off switch.

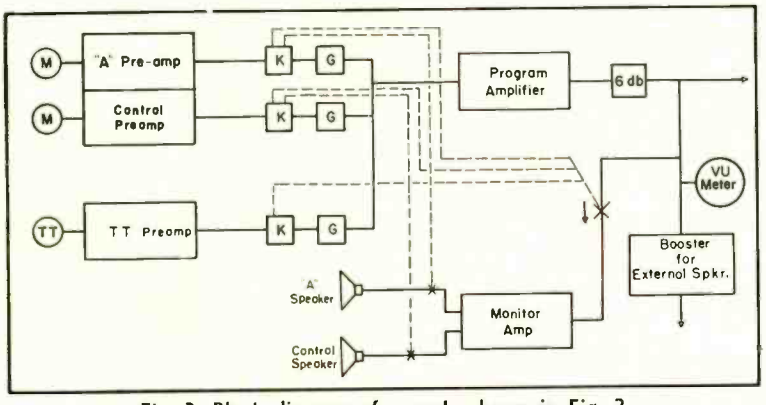


Fig. 3. Block diagram of console shown in Fig. 2.

In the up position the studio "A" key switch allows the person in "A" to talk to control. In neutral the mike is off, when down it is on the air. The control room switch is used in the same way except when up, it allows the operator to talk to "A". The turntable switch auditions in the up position.

Again the equipment was not designed for very high fidelity—(30 miles of grade D line). An *RC* circuit was included in the program amplifier to give a rise of about 6 db at 5000 cps to compensate partially for the line. This allowed us to terminate the line in our console directly without using an equalizer at the station. We can, therefore, talk back and forth on the line without going through the 20 db loss a regular equalizer might insert.

"One-Man" Operation

Francis Mangold, who runs the shows in Washington, had previously been our news correspondent there. With the studio installation he had to learn to sell radio time, announce, carry on a fifteen minute man-on-the-street show and keep sponsors on the air. Needless to say he was very, very happy to find he did not have to learn to manipulate a "maze of knobs, dials, and buttons" in addition to his other duties. We carry three 15-minute shows daily from there and the advertisers are quite pleased with the results.

The circuit diagrams of both units described were purposely left out. Every station has its own problems and fidelity requirements; therefore each should custom design equipment of this type.

Optimum Use of Nickel Alloy Steels in Low-Level Transformers

L. W. HOWARD*

A statement of the problems involved in making a line of high-quality transformers, and a useful bibliography on transformer design.

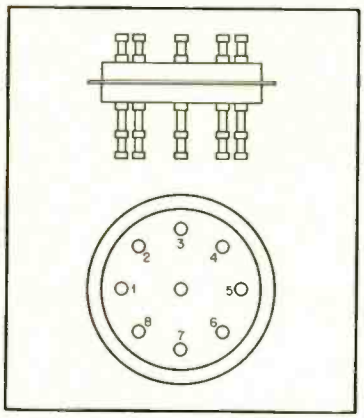


Fig. 1. Terminal arrangement which permits an adequate number of connections for multilead transformers.

THE PROPERTIES OF THE NICKEL ALLOY series of lamination steels which make them desirable for use as core materials and as a shielding material for low-level transformers have been known and commercially applied for a good many years. By a series of relatively small gains in the design techniques, the engineers in the industry have attained results which, when accumulated over a long period of time, represent major advancement in performance. Application of all of these new developments in any given application is frequently limited by economic considerations, the necessity for making use of expensive dies already purchased, the losses involved in obsoleting stocks on hand, etc. It is all too infrequent that any group of engineers has the opportunity to review all advances in technique, select the most adaptable to the problem under consideration, and to tool from scratch with no limitations due to use of dies already on hand. Such a development program is described in this article.

Since new tooling was involved, it became desirable to review all possible uses for such tooling and to make each die serve a purpose in each of several possible lines.

A tentative series of designs was developed for each of three fields of application in which the properties of the nickel alloy series afford promise of improved operation. A group of dies were then laid out to adapt themselves best to these designs. The groups of transformers around which this development grew were as follows:

A. Low-level wide-range transformers.

The high permeability of the nickel alloy steels at very low levels makes them particularly desirable for use in wide-range designs. High inductance values are obtainable without excessive leakage inductance or capacitance being developed, even when such transformers show relatively high gain. If full advantage is taken of this feature, a wide-range low-level transformer can be built into a very small space.

B. Transformers for geophysical prospecting equipment.

Geophysical equipment involves a different series of objectives in that only very low frequencies need to be considered, but low phase shift, high inductance, high gain, and above all, exact reproduction of characteristics, are of major importance. The equipment is portable in application, and as more and more channels are crowed into a typical prospecting truck, small size and weight become secondary in importance only to the electrical performance. A very high degree of shielding is required because of the high gain and sensitivity at line frequencies. All of these requirements are best met by use of properties of the nickel alloy steels.

C. Miniature components.

Using the high permeability of the nickel alloy steels to attain a reasonable amount of inductance in a small space permits the manufacture of transformers for practically all low-level applications with sizes which are only a fraction of that required for normal transformers designed for the same purpose. Since most of the equipment is battery operated and response at line frequencies is greatly attenuated, the shielding problem is not acute.

Common Problems

Problems which were common to the three groups were as follows:

A. SIZE: In all of the types of equipment for which these transformers are designed, extreme portability where obtainable without sacrifice in performance is desirable. Tooling was set up to reduce size and weight to the absolute minimum

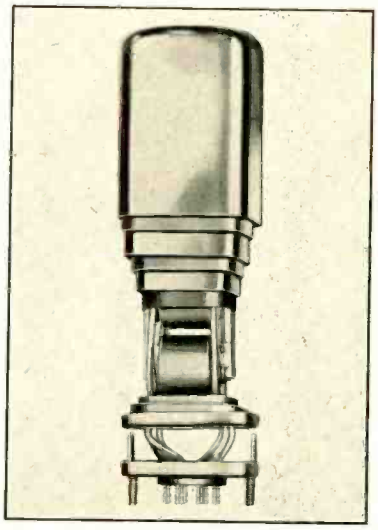


Fig. 2. Transformer case composed of nested alternate layers of nickel-alloy and copper shields.

in all types. External cases were also to be shielding cases, to eliminate even one thickness of electrically inactive material.

B. MOISTURE PROTECTION: It was felt that wartime developments in hermetic sealing, as exemplified in the JAN-T-27 specifications, provided a good standard. Satisfactory terminals of molded, mineral-filled, low-loss phenolic were available but did not provide an adequate number of terminals in the small area available in the new miniature series of cases. Two new types were therefore

* *Triad Transformer Mfg. Co., 2254 Sepulveda Blvd., Los Angeles 64, Calif.*

developed, providing, respectively, nine terminals in 23/32 in. diameter and twelve terminals in 7/8 in. diameter. These seals use sturdy turret-type studs molded into the plastic and with their identifying number molded nearby as shown in *Fig.* 1. Soldering techniques and vacuum apparatus for impregnation and filling of the transformers were already included in the production equipment available.

C. MAGNETIC SHIELDING: The problems of shielding against stray fields and of the external case must be considered together when minimum size is to be maintained. Previous experience had indicated that a maximum of three high-permeability nickel alloy shields, interleaved with heavy copper shading rings, would be necessary to provide the reduction in pickup of stray fields needed for the lowest level transformers. Due to the wide range in transformer size and handling capacity, it was necessary to provide seven sets of case dies, each usable either as an external case or as an interior shield. These cases were designed so that the smaller cans nest within the larger with room between for the heavy copper shading rings, as shown in *Fig.* 2.

The equipment used in checking shielding efficiency is also of interest. As illustrated in *Fig.* 3, the transformer is positioned on the platform in the center of the Helmholtz coil, the large diameter of the coil ensuring a weak and uniform field for testing. Standard procedure is to check the transformer in two planes at right angles to each other, the results being strictly comparative with a similar unshielded unit.

D. FREQUENCY RANGE: The transformers involved in this problem are divided into three groups:

1. *Wide-range components.* It was felt that a minimum standard of 20 to 20000 cps ± 1 db should be maintained. Where wider range could be attained without increase in size or weight, this was done.
2. *Geophysical components:* Depending upon portability in the particular piece of equipment to be designed, 5 to 500, 10 to 500, or 20 to 500 cps, ± 1 db were determined as standards. Several designs were to be available for each standard function. Where possible without sacrifice of other desirable characteristics, frequencies above 1000 cps were to be attenuated.
3. *Miniature components:* Nickel alloy cores were used to attain minimum size rather than wide frequency range. The voice frequency range of 250 to 5000 cps, ± 1 db, is all that is considered necessary.

E. HANDLING CAPACITY: The nickel alloys are not too useful in the larger transformers due to their low saturation point. High-quality silicon steels are therefore more adaptable to high-level output transformer designs. Generally speaking, transformers in the groups described in this article were in the operating range below 20 VU.

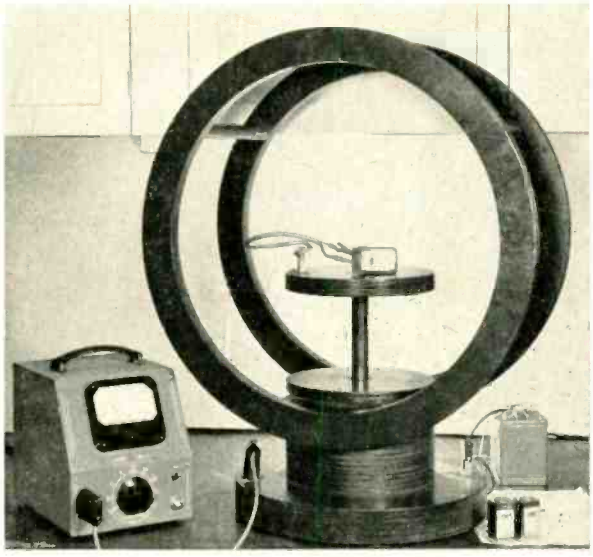


Fig. 3. Equipment used for testing efficiency of transformer shielding.

Conclusions

Since it is important that size be held to a minimum in all types, extremely accurate winding equipment and great skill in winding are necessary to handle the fine wire sizes which must be used. Such fine wire coils open up easily under moist conditions or mechanical movement. Therefore it is urgent that the windings be completely dried and all voids filled with non-hygroscopic and non-acid material. Only the most highly developed of vacuum-treating equipment is satisfactory. We have also found it almost imperative that the transformers be hermetically sealed and filled with compound under vacuum.

Possibly the emphasis placed on minimum size in this article seems overdone; however, not only is size important in the applications where these transformers are used, but keeping physical dimensions to a minimum permits reduction in leakage inductance and in capacity, thus permitting a more extended frequency range. *Figure* 4 shows a series of transformers made in a variety of case sizes.

The attached bibliography covers a number of articles which have appeared in the Proceedings of the Institute of Radio Engineers. The audio design chapters in Dr. Terman's "Radio Engineering" and "Radio Engineers Handbook" are also particularly helpful.

Fig. 4. Complete line of transformer cases for units of various sizes.

BIBLIOGRAPHY

All references to *Proc. I.R.E.*

Manfred Von Ardenne, "On the Theory of Power Amplification," Feb. 1928.

J. M. Thomson, "Characteristics of Output Transformers," Aug. 1928.

Glenn Koehler, "The Design of Transformers for Audio-Frequency Amplifiers with Pre-Assigned Characteristics,"* Dec. 1928.

V. D. London, "A Bridge Circuit for Measuring the Inductance of Coils While Passing Direct Current," Dec. 1928.

John Minton and Ioury G. Maloff, "Design Methods for Soft Magnetic Materials in Radio," June 1929.

E. L. Chaffee, "Equivalent Circuits of an Electron Triode and the Equivalent Input and Output Admittances," Sept. 1929.

H. M. Turner, "Inductance as Affected by the Initial Magnetic State, Air-gap and Superposed Currents," Oct. 1929.

Arthur E. Thiessen, "The Accurate Testing of Audio Amplifiers in Production," Feb. 1930.

C. E. Kilgor, "Graphical Analysis of Output Tube Performance," Jan. 1931.

H. J. Reich, "A New Method of Testing for Distortion in Audio-Frequency Amplifiers," March 1931.

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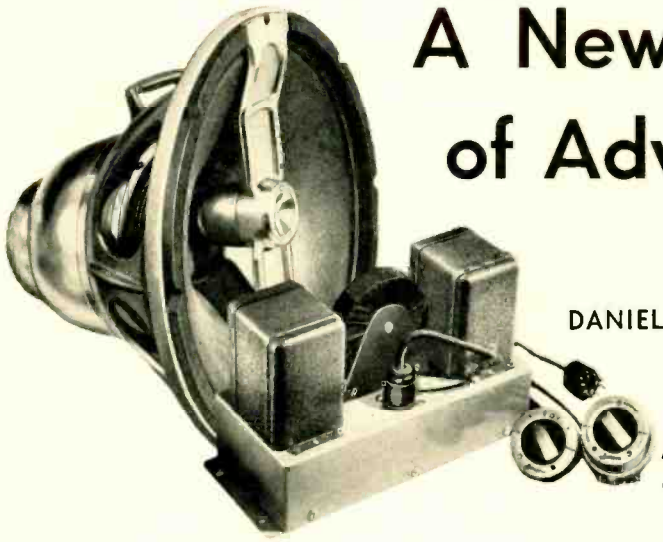
A New Loudspeaker of Advanced Design



DANIEL J. PLACH* and PHILIP B. WILLIAMS**

A description of a new unit which was designed for the most critical applications in sound reproduction.

WITH THE ADVENT of better audio sources, the performance requirements of loudspeakers have become more stringent. Improved studio equipment for FM and AM, the development of high-quality magnetic tape, and the introduction of microgroove recordings have offered extended range material requiring a loudspeaker of greatly improved performance. Response range is but one of the essential considerations. In addition, the following requirements must be met:

1. Smooth response
2. Balanced response
3. Good spatial distribution
4. Good transient response
5. Low distortion
6. Satisfactory efficiency
7. Adequate power handling capacity

Existing materials suitable for use in loudspeaker diaphragms have mass and stiffness limitations which make it impossible for a single-channel system to conform to all the previous requirements. Quasi-two-channel systems employing a single voice coil, a conventional cone, and a thin metal dome are notably deficient from the standpoint of transient response, range, and efficiency. This type of radiating system is productive of harshness and "edginess" attributable to unsuppressed resonant modes in the metal dome.

Inherent advantages of the compression or horn type radiator, as shown in *Fig.* 1, make its use desirable in the upper spectrum of multichannel systems. Because of horn loading of the diaphragm, it is possible to attain extremely high efficiencies and smooth response. The large degree of loading attainable makes it possible to reduce distortion by decreasing the diaphragm excursion for a given amount of sound power output. The improvement results from reduction of non-linear distortion effects arising from movement of the voice coil beyond the region of uniform flux density and prevention of movement of the diaphragm suspension into the region of non-linear stiffness. By proper configuration of the horn mouth and flare, it is possible to attain very good spatial distribution over a large part of the operating frequency range.

Here, too, practical limitations apply. It can be shown from energy considerations that the displacement of the diaphragm with applied signal is:

$$X = \frac{1}{2\pi f}\sqrt{\frac{nP_e \times 10^7}{R_h}} \qquad (1)$$

where X = diaphragm displacement in cm.
f = frequency in cps.
n = efficiency
P_e = electrical power input in watts
R_h = effective load on diaphragm in mechanical ohms

Equation (*1*) shows that the displacement varies inversely as frequency and therefore becomes large at low frequencies. Consequently, to reproduce low frequencies at substantial powers, the clearance between sound chamber and diaphragm must be relatively large. Clearance also must be kept large compared to the displacement to avoid serious distortion effects due to compressibility of the air and non-linear viscosity effects. At the same time, the moving system must be a dependable mechanical device, capable of undergoing the required motions for indefinitely long service without structural failure.

A horn-type loudspeaker can be treated as a band-pass filter. From considerations of equivalent circuits of horn units as in *Fig.* 1, the high-frequency cutoff is given by:

$$f_c = \frac{1}{2\pi}\sqrt{\frac{S_c}{M_d}} \qquad (2)$$

where f_c = cutoff frequency in cps
S_c = stiffness of sound chamber air volume in dynes per centimeter
M_d = dynamic mass of moving system in grams

Above f_c the sound output falls off rapidly. For efficient reproduction at high frequencies, equation (*2*) shows that the mass must be held to an absolute minimum and the sound chamber stiffness made large. The latter is accomplished by use of comparatively small sound chamber clearances.

Thus it can be seen that satisfactory power handling capacity at lower frequencies and high efficiency at high fre-

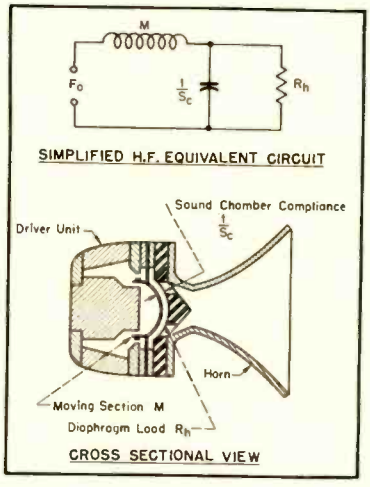


Fig. 1. Compression-type high-frequency unit.

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quencies are requirements which are not compatible over a wide frequency range. An additional complicating factor is that distortion increases in proportion to the frequency span which is attempted in a single unit. It was accordingly considered impractical to attempt to cover the entire middle- and high-frequency range satisfactorily with a single unit. Examination of commercial tweeter units intended to cover three or more octaves clearly confirms the predicted limitations on bandpass width at this stage of the acoustical art. Objective measurements indicate that an all too prevalent commercial practice is to design for sufficient mass and clearance to allow satisfactory lower-frequency performance and then greatly to overrate the actual high-frequency response.

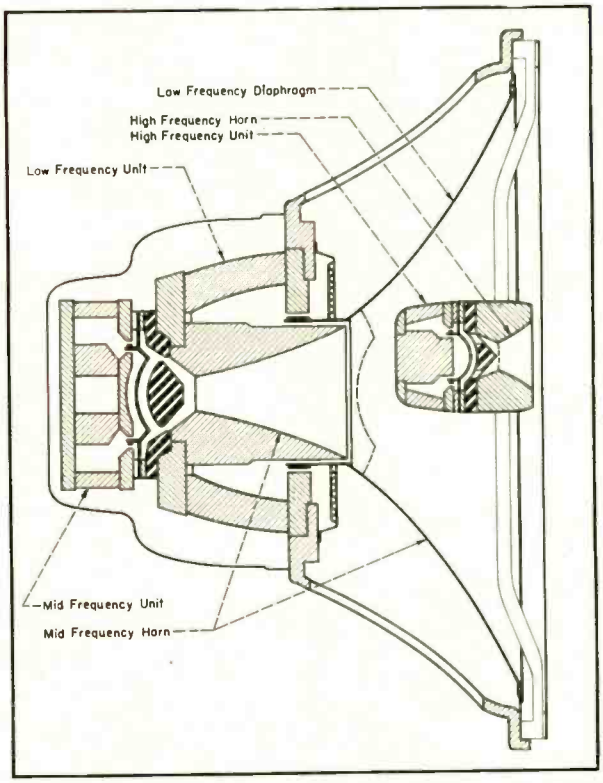


Fig. 2. Cross-sectional view illustrating arrangement of the three channels.

Design Objectives

As a result of these considerations, verified by considerable experimental work, an extensive program was undertaken to lead to the development of a compact three-channel loudspeaker which would satisfy the eight requirements previously listed. Intended uses were to include high-quality monitoring from live material, tape recordings, custom-built radio phonographs, FM reception, and any other application where the finest possible performance is essential. It was also to serve as a tool for the development and subjective testing of audio components and equipment. However, to allow its use with source material of limited range and noticeable distortion and noise, provision was to be made to adjust high-frequency cutoff to the capabilities of the source.

All acoustic elements were to be properly integrated into a unitary structure in which electrical and space phasing problems were presolved before installation. Such a design would then be free from the detrimental effects encountered in physically separated radiating systems. The first crossover frequency was to be set at the lowest possible value consistent with the dimensions of the integrated structure in order to maintain piston-like behavior over the entire range of the low-frequency unit. A desirable goal was set at 600 cps. This figure was to be the actual attained acoustic crossover rather than the theoretical electrical crossover. The latter figure is sometimes given and does not necessarily reflect the actual system behavior.

The mid-channel radiator would have a sufficiently large horn mouth area for smooth reproduction down to 600 cps, and at the same time maintain wide-angle radiation up to the second crossover frequency, which was ultimately established at 4000 cps.

Considerable commercial experience and long continued transducer development programs resulted in the decision to use plastic diaphragms in compression units of the G-610. The high internal damping characteristic of phenolic material discourages undesirable modes of vibration that are detrimental to faithful transient response. This durable material tends to be free from the sharp resonances and "birdies" that are typical of metallic diaphragms.

It was considered necessary to utilize extraordinary powerful magnetic structures to attain high efficiency and good transient performance. High flux density in itself does not produce high efficiency. The volume of voice coil conductor in this flux field is also a factor. For this reason, total magnetic energy is a preferable criterion of magnetic efficiency. A minimum total energy of 36 million ergs appeared desirable from these considerations.

Design Achievement

The Jensen Model G-610 Triaxial three-way loudspeaker system is the result of intensive development directed toward the attainment of these objectives. It consists of a loudspeaker composed of three independently driven reproducers and a separate control and crossover network.

The low-frequency unit covers the frequency range to 600 cps. The radiating surface is a 15-inch Hypex formula[1,2] curved cone driven by a massive three-inch diameter voice coil. Complete freedom from hangover effects and boominess is provided by efficient utilization of a 6½-pound Alnico V magnet providing airgap energy of 30 million ergs. The unusually large spider and rigid cone were designed to achieve good linearity and low distortion even at high operating levels.

The mid-frequency unit employs a rigid re-entrant type phenolic diaphragm with an annular takeoff passage and driven by a two-inch voice coil. Because of the limited frequency range in this channel, it has been possible to use a rugged two-gram moving system and very large clearances, resulting in great peak power handling capabilities and low distortion. Through the use of a dual concentric magnet arrangement, a high airgap energy is provided in a small volume of magnetic material with airgap flux density of 17,500 gauss. This driver is coupled into a Hypex horn as shown in *Fig. 2*. The initial section of the horn passes through the core of the low-frequency channel, and the final section is formed by the curved cone. The large effective horn mouth size provides good loading, resulting in smooth response at high efficiency down to and

[*Continued on page 62*]

[1] *Electronics*, July, 1941.
[2] Patent 2,338,262.

"Williamson" Type Amplifier Using 6A5's

J. H. BEAUMONT*

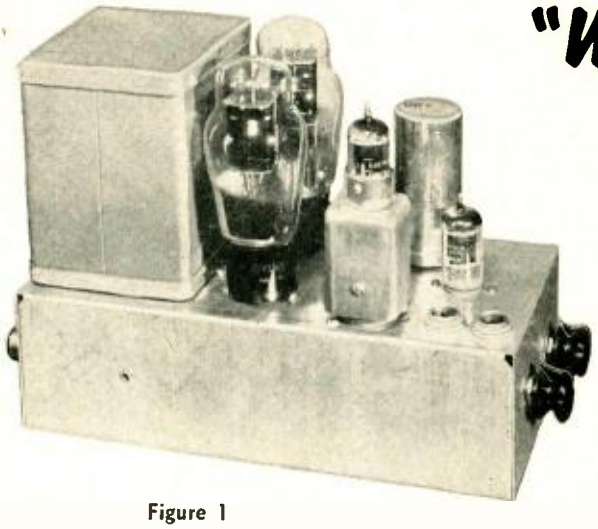


Figure 1

A simple and effective amplifier based on the now-familiar circuit originally appearing in "Wireless World."

THE CONTINUALLY INCREASING POPULARITY of the Williamson amplifier among music lovers and technicians alike prompts another version of this circuit, the third to appear in this country. Designed for 6A5's, it will not deliver as much power to the speaker as either of the others; but use shows its nominal rating of six watts to be ample for home use. The arguments for and against large reserve power have never been resolved among engineers, and no attempt will be made to do so here. The low-power amplifier is regaining its popularity after having been nearly lost in the welter of claims that grew up around amplifiers using the 6L6 and the attendant fanfare about 25- and 30-watt outputs. There is no particular need for arguing that there should *not* be as large a power reserve as is reasonably possible since most circuits exhibit greatly improved distortion and linearity characteristics when they operate well below their ratings, but it is worth considering that the average power delivered to the speaker for "normal" room volume in the usual living room is of the order of 6 milliwatts, as has been established by tests. On this basis, the thousand-to-one reserve ratio of this amplifier seems adequate. If an efficient speaker is used, the amplifier will produce more volume than most listeners can tolerate, with sufficient reserve to maintain clean reproduction of any music.

The original plan was to provide a fixed gain package which would operate from a preamplifier containing all the necessary controls. However, the idea of a self-contained preamplifier seemed so attractive that it was added to the design, with consequent modifiations in the circuit. To avoid an additional stage of gain, high-mu triodes were used for inverter and driver stages. The direct-coupled inverter was changed slightly to conform to the configuration of the direct-coupled preamplifier in order to preserve uniformity and to ensure the excellent characteristics which have been observed with this arrangement in several circuits. Direct-coupled pairs, which are a characteristic of the Williamson, are seldom seen in amplifier service, though their use for this purpose was established in this country as long ago as 1940.[1] The configuration shown here has been used for some five types of stages with considerable satisfaction. The cathode circuit of the 6A5's had to be modified because the cathodes in these tubes are tied to the filaments. There are no other major changes from the original circuit. The output transformer chosen was a Freed F-1951, which gives excellent results. Miniature tubes were used in place of octals because of the higher mu available in this series. *Figure* 1 shows the external appearance of the complete amplifier.

* *49 Beach St., New York, N. Y.*

Preamplifier Description

Starting at the input plug, let us consider those parts of the circuit that merit discussion. The preamplifier, which is constructed in a Vector plugin can, is a familiar circuit which has been modified slightly for direct coupling. Its operating characteristics remain essentially the same as the capacitance-coupled version. Referring to the schematic, *Fig.* 2, the input grid resistor, R_{11}, was set at 0.1 meg because this value works well with the General Electric cartridges which were used with this amplifier. When other cartridges are to be used, it is preferable to use the values specified by the manufacturer for flat response.

R_1 and C_5 form a compensating network in the feedback loop to eliminate the tendency of this preamplifier circuit to droop at frequencies above the crossover point, a condition which is inherent to the circuit since the crossover point is located on the knee of the compensation curve produced by the feedback-loop components. When this droop is added to that often found in cartridges and present even in amplifiers which are rated flat, the result can be as much as a 5-db drop at frequencies between crossover and 5,000 cps. This is sufficient to be noticeable, and has an effect of reducing the brilliance of music. The compensating network tends to decrease the feedback as frequency increases, thus offsetting the droop. Values for these components may have to be varied to suit an individual amplifier, but normally the capacitor should have a reactance of about ten times R_3 at the crossover frequency. If the response rises, the value of the capacitor should be decreased; if response drops off, C_5 should be increased. R_1 may vary between the value of R_3 and one-half that value, increasing if there is a rise at 10,000 cps, and decreasing if there is a droop at this point.

Adjustment of the network was made with a Cook Series 10 frequency record so that the cartridge would be included. The pickup used with this amplifier exhibits excellent response characteristics with the Cook record, showing no more

[1] C. G. McProud and R. T. Wildermuth, "Direct-coupled input stage for phase inversion in audio amplifiers," *Electronics*, October 1940.

than plus or minus 1-db variation through 10,000 cps.

The preamplifier may be built on a regular Vector socket if the plug-in feature is not desired. However, the preamplifier plug-in socket may be used as a source of power for an external preamplifier if at any time it is desired to use one, and plug-in preamplifiers allow changes to be made without disturbing the internal wiring. The circuit shown here is the third used with this amplifier since its construction was started. It is worth noting that if the octal socket is used as a source of external power there can be no heater grounds in the external equipment because the heater string is connected to the 6A5 cathodes and is "off ground" by the amount of their bias. If a separate heater pair is supplied on the power supply used with the amplifier, it may be wired to the preamplifier socket, though in general, the d-c bias on the heater string is considered desirable.

Parts mounting on the post of the Vector unit will be much simplified if the screw joining the parts is taken out and the octal plug removed entirely. This allows the post to be rotated so that its lugs are conveniently located with respect to the novel socket lugs. Components which pass into the octal base, such as C_4, should be fastened at one end and plenty of lead length left on the other. Leads from the lugs to the socket are fastened to their lugs and left projecting below the end of the post far enough to pass through the octal pins. Fiber-glass sleeving should be used on leads only where one crosses another, or comes near a lug; the rest of the wiring may be done with bare wire. *Figure* 3 shows the appearance of the preamplifier, both cased and uncased.

When all wiring and soldering is complete, the octal plug is re-assembled and all leads passed through their respective pins. When the screw has been tightened, the lead ends are cut off flush with the pins and soldered. If a layout is made before assembly is undertaken, it is possible to arrange the parts so that all the leads will pass almost straight from the post into the plug pins. The ground lug on the base of the can should be connected to the common ground point of the preamplifier.

The remainder of the stages were wired on Vector sockets because they offered an interesting approach to parts mounting which could be completed stage by stage and inserted in the chassis with all leads attached. This simplifies assembly greatly, and the resulting job will be both compact and neat, as shown in *Fig.* 4. This type of mounting avoids the troubles often found in getting strip mountings to operate satisfactorily due to the necessarily greater length of critical leads. The only critical leads leaving the Vectors are the grid leads of the following stage, and the capacitors may be hung from one socket to the next if these give trouble.

Further ease in assembly can be obtained by using a 6 × 10 Bud Minibox in place of the chassis indicated here. These boxes come in two sections, one of which forms the top and ends of a chassis, and the other the sides and bottom. Work on the top section can be done, unhampered by sides, and the completed unit will be housed in a neatly finished box.

Moving into the amplifier proper, R_{15} and R_{16} provide isolation for the two inputs and R_{36} is the gain control. The amplifier-inverter stage has the same basic configuration as the preamplifier and requires no comment, except that R_{18} and R_{19} should be a matched pair to obtain as nearly a balanced output as possible. C_6 and C_7 were intentionally made small in value in order to preserve a smooth bass response down to the low-

PARTS LIST

R_1, R_2	2200 ohms, ½ watt
R_3, R_4	3900 ohms, ½ watt
R_5, R_6	10,000 ohms, 1 watt
R_7, R_8	47,000 ohms, 1 watt
R_9, R_{10}	68,000 ohms, 1 watt
R_{11}, R_{15}, R_{16}	0.1 meg, ½ watt
R_{12}, R_{13}, R_{14}, R_{17}, R_{20}, R_{23}, R_{25}	0.1 meg, 1 watt
R_{18}, R_{19}	0.1 meg, 1 watt, 5%
R_{24}, R_{35}	0.27 meg, ½ watt
R_{26}, R_{27}	0.47 meg, ½ watt
R_{28}, R_{29}	45 ohms, 2 watt, 5%
R_{30}, R_{31}	100 ohms, 2 watt
R_{32}	350 ohms, 10 watt wirewound
$C_{10a, b, c, d}$	20–20–20–20/450 v, electrolytic
C_1, C_2	0.1 µf, 400 v, Aerolite
C_3, C_5	.01 µf, 400 v, Aerolite
C_6, C_7	.004 µf, 400 v, Aerolite
C_8, C_9	.002 µf, 400 v, Aerolite
T_1	Output transformer, Freed F-1951
V_1, V_2, V_3	2AX7
V_4, V_5	6A5
P_1, P_2	Amphenol 80-C
P_3	Jones P-202
P_4	Jones P-306-AB
P_5	Octal socket, Amphenol MIP-8
	Vector B8-N socket ass'y (1 req)
	Vector 10–O–9T, (2 req)
	Vector 8–N–9T (2 req)
	Aluminum chassis, 5 × 10 × 3

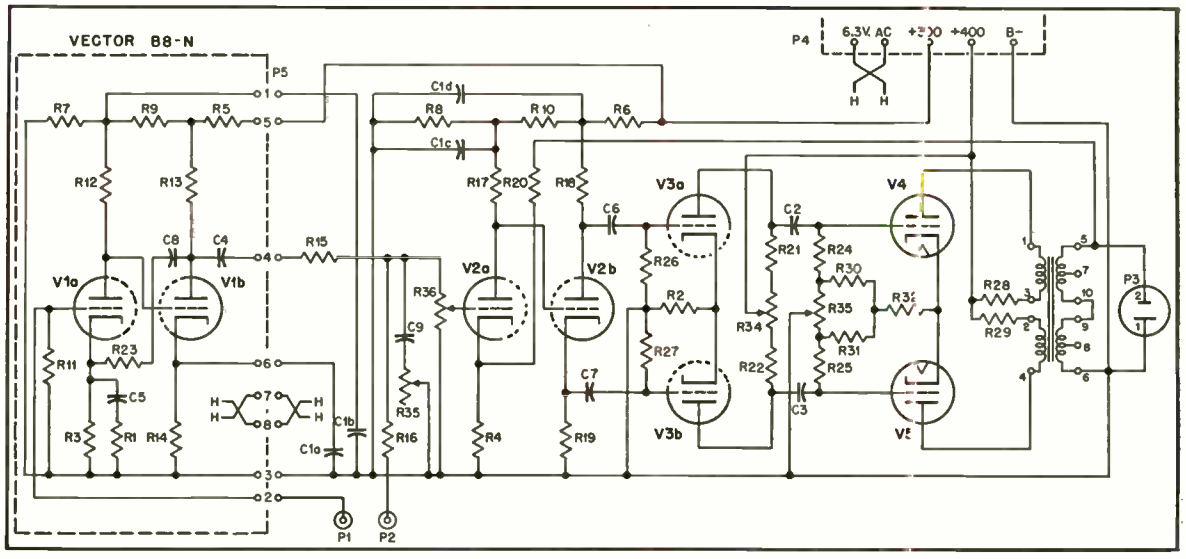


Fig. 2. Complete schematic of the 6-watt amplifier described.

est frequency because feedback loops around two or more stages usually require that some adjustment be made within the loop to avoid response peaks at the frequency extremes, with consequent oscillation. A simple means of achieving this is to make the response of one stage poor with respect to the others.[2] There seemed to be no need of special components to reduce the high-frequency response, and the amplifier exhibits excellent stability throughout its range.

C_9 and R_{35} provide a controllable high-frequency roll-off. These values provide approximately 20-db loss at 10,000 cps. This is ample to provide proper equalization for long-playing records. No high boost was desired, or considered advisable. When the response of a system can be made truly flat to at least 20,000 cps there should be no need of high boost. All long playing records require de-emphasis; most shellac records of recent vintage have pre-emphasis added, and will require a certain amount of de-emphasis. In other cases, surface noise becomes excessive when boost is used to capture highs on a record where they are deficient.

No bass control is provided in this design at all. If one is desired it may be added either internally or as part of an external preamplifier. It can be shown that a satisfactory bass compensation can be worked out for virtually all records so far as their recording characteristic is concerned,[3] and that the crossover frequency may be adjusted by listening preference. Beyond this there is a legitimate doubt that control is needed, except to compensate for low listening levels which may best be done in any case with a loudness control. While it is true that records vary in bass response, so do live concerts, and this variation should be considered as a normal part of listening. An amplifier should have a clean and flat response down to its lowest frequency to assure

[2] F. E. Terman, "Radio Engineer's Handbook," p. 397 ff, 1st Edition. New York: McGraw-Hill Book Co., 1943.
[3] Howard T. Sterling, "Simplified Preamplifier Design," AUDIO ENGINEERING, November 1949.

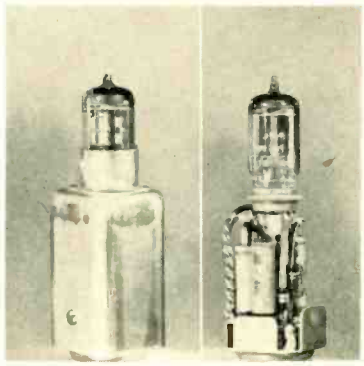


Fig. 3. The plug-in preamplifier, cased (left) and with the case removed (right).

the *clarity* of bass reproduction, which is more important than any amount of volume.

R_{34} in the plate circuit of the driver serves to balance the signals to the grids of the 6A5's. Should any serious unbalance occur when the control is at its mid-point, preceding circuits and tubes should be checked. R_{33} equalizes the plate currents of the 6A5's by adjusting a portion of the bias voltage to which the grid returns (R_{24}, R_{25}) are connected. The balance is read by connecting a milliammeter at the points marked *2* and *3* on the output transformer. Balance within a few microamperes can be obtained when the circuit is warm. R_{28} and R_{29} must be matched within 1 per cent to ensure an accurate reading, and 10 per cent resistors may be matched on a bridge to find a pair. This method was used because cathode metering cannot be used with 6A5's—their cathodes being effectively tied together by the filament wiring.

No power supply is shown inasmuch as none was built specifically for the amplifier. The supply voltages shown on the schematic may be obtained from any well designed supply. With these voltages the amplifier is in a somewhat overbiased Class A condition. If the 6A5 supply voltage is reduced to 300 volts and R_{32} adjusted to give 45 volts bias from cathodes to ground, the tubes will then be operating at their rated Class A point.

The strapping of the output transformer shown in *Fig. 2* is for a speaker load of 16 ohms. Other strappings may be determined from the instructions accompanying the transformer. The feedback, using the component values indicated, will be approximately 5 db. The amplifier is stable under all conditions observed, and the driving conditions are such that more feedback would have required more gain elsewhere in the circuit for full output, which did not seem desirable. The over-all response of the equipment is essentially flat from 35 to 20,000 cps, using the Cook record, and the listening quality of the amplifier fully validates the superiority of the Williamson circuit.

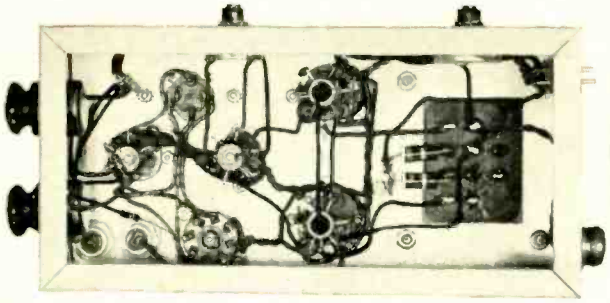


Fig. 4. Under chassis view of the amplifier. Note the neatness resulting from the use of Vector sockets.

NAB Inaugurates Voice of Democracy Contest in Schools

A series of five "model" talks have been transcribed by prominent national figures for the 1950–51 Voice of Democracy Contest, it was announced recently by the VOD Committee Chairman Robert K. Richards.

Voices to be heard in the 4–4½ minute programs, currently being pressed by RCA, are those of Supreme Court Justice Tom C. Clark, VOD Honorary National Chairman, (speaking on "Platform for Democracy"); Senator Edwin C. Johnson (D), Colo., (speaking on "Democracy at Work"); NAB President Justin Miller (speaking on "Freedom of Expression"); U. S. Commissioner of Education Earl J. McGrath (speaking on "Education for Democracy"); and Representative Brooks Hays (D), Ark., vice-president, Southern Baptist Convention, (speaking on "Freedom of Worship").

NAB member stations will begin Oct. 1 to receive the transcriptions to be scheduled during National Radio and Television Week, Oct. 29–Nov. 4, as guides for students competing.

Guide manuals of procedures and rules for the Fourth Annual VOD Contest for the best broadcast scripts by high school students are currently being mailed to all NAB stations, 28,000 high schools, and Junior Chamber of Commerce chapters. These manuals outline the deadline dates of the contest and suggest means of cooperation between local representatives of the three sponsoring organizations in promoting the event. The sponsors are the National Association of Broadcasters, the Radio-Television Manufacturers Association, and the U. S. Junior Chamber of Commerce. The competition is endorsed by the U. S. Office of Education, Federal Security Agency.

The contest for students in the second, third and fourth years of high school, now entering its first phases, will reach a climax during National Radio and Television Week, and culminate in a national awards luncheon on Washington's birthday in Feb. 1951, at which time $500 college scholarship awards will be made to the four national winners.

Not an oratorical or essay contest, the competition is judged by broadcasting standards, with special weight given to content, delivery and originality. National and state judging is done by transcriptions made by local radio stations.

AUDIO engineering society

Containing the Activities and Papers of the Society, and published monthly as a part of AUDIO ENGINEERING Magazine

Audio Engineering Society,
Box F, Oceanside, N. Y.

Automatic Audio Gain Controls

J. L. HATHAWAY*

A discussion of the development and application of program-controlled circuits in broadcasting, with a description of a general-purpose AAGC amplifier in regular use.

MANY OF THE AAGC's in service are necessarily of compromise design. For example, in extremely portable battery-operated equipment, such as radio mikes or pack transmitters, it is hardly practical to utilize all of the refinements of a high-quality studio control unit. A tiny transmitter cannot devote sufficient filament power or bulk to push-pull control tubes and balancing transformers so that a single-sided system is generally used. This leads to a condition of regeneration or degeneration, depending on the number of stages, and also to creation of severe plop components. The general cure for both of these ailments is the same—the use of an extremely slow attack time around 50 to 100 milliseconds. Although it might seem that this would render the control virtually useless, such is not the case. Tests on high-level input to units incorporating even this imperfect control show that great benefit is derived as compared to similar equipments without any form of automatic control. Without the control, overmodulation becomes serious and causes the "rasping" type of distortion which is disagreeable and at the same time intelligibility is reduced. With the control, the rasping distortion is eliminated, and quality, except for a few slight plops, is generally good. Furthermore, average level may be increased many db when the AAGC is employed.

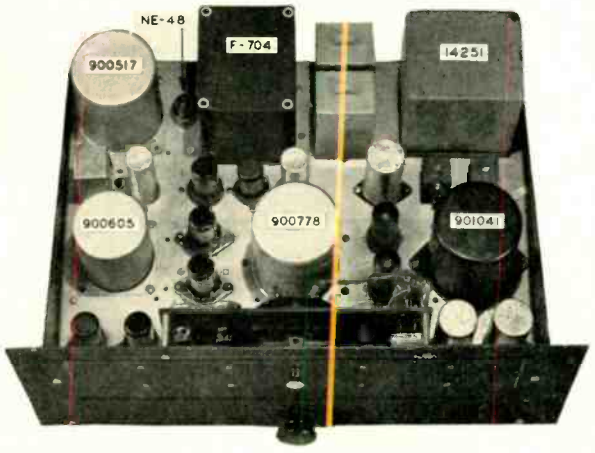


Fig. 5. Top view of ND-333 AAGC amplifier.

Dual Controls

Applications wherein extremely wide level variations are likely to occur call for double-action control. Our studio units are of this type and some of these are used without manual assistance as, for example, in news flash booths. The philosophy leading to the development of these dual controls was basically as follows: with normal input, a limiter type of control would be thoroughly satisfactory. But suppose a speaker were close to the microphone and also had louder-than-normal voice—the microphone output might easily be 20 db or so above normal. This condition frequently exists in practice, especially when the speaker must override a high ambient acoustical noise level. Thus, peak gain reductions of 20 to 22 db are not uncommon, and this is too much for an ordinary limiter since gain rises too rapidly during slight pauses, producing a continual rising and falling effect which removes syllable emphasis and creates an unnatural and displeasing sound. If, however, control adjustment were made slowly in the microphone circuit ahead of the limiter, the rapidly rising gain during pauses would be evident only during the first few spoken words, that is, during the transition period prior to attentuation of average level by the first circuit. Thereafter the input level would be held down to just slightly above normal. If long pauses existed, the input would slowly restore gain towards maximum. Thus the functioning of such a double circuit might be likened to a person's neck and eye action wherein he glances only with the eyes at objects which are to be viewed but momentarily. When prolonged viewing is called for, the neck automatically turns to relieve the eyes of most of their displacement after which the eyes are in better position for continued viewing. The slow averaging of the dual control is thus similar to neck action, whereas the rapid limiting is similar to eye acton.

Units employing two controlled stages have served satisfactorily in studio operations for the past twelve years. These operate with the first stage functioning on average level. The second stage, having a rapid attack time, is always available for conventional limiting. Recently, in order to simplify and further improve this double action, designs have utilized a double-time-constant circuit operating in a single controlled stage. Here two radically different time constant *RC* circuits are operated in series in such manner that a small capacitor is quickly charged by a single peak in the control rectifier. A much larger capacitor is slowly charged, requiring many peaks to

* *National Broadcasting Company, New York.*

accumulate an appreciable charge. But if a high signal level persists for a sizable fraction of a second, the voltage across the larger capacitor becomes equal to or even greater than that across the smaller, due to the ratio of discharge resistors. Therefore, after only a few short program bursts, most of rectified control potential appears across the small capacitor and recovery rate is rapid—about 0.5 second for 90 per cent recovery. However, after continued peaks most of the rectified potential accumulates across the large capacitor, allowing the rapidly acting circuit to relax in its activity. The resulting recovery rate after prolonged peaks is relatively slow—about 2 seconds for 50 per cent recovery and 8 to 12 seconds for 90 per cent recovery. Again it should be brought out that limiting action, with this type of double time constant circuit, is always available for holding down unduly high level peaks. Such a dual control is desirable for any of the various applications where extreme portability is not required.

The most recent AAGC developed at NBC, Type ND-333 studio control unit, is pictured on *Fig.* 5. It is operated in place of a regular studio amplifier, having sufficient gain for operation between the mixer output and the program bus. It has a maximum voltage gain of 81 db, will control programs at as low as –75 VU, and has a maximum output power of around 4 watts at 15 ohms impedance. It is a rack mounted unit, powered from either a house battery supply or the 115-volt a.c. line. All controls except the meter switch are located behind the hinged front panel door in order to reduce the likelihood of undue tampering.

Three different control characteristics are remotely selectable to suit the particular program material, two relays mounted on the chassis providing for this remote selection. The *modified limiting* characteristic previously described is used for all programs of local origin, with the exception of symphony and opera. For these, the *compression* characteristic is available. The *nemo* or *limiting* characteristic is for the programs from outside the studio where the program has previously undergone automatic gain control. Thus, no additional control is introduced for normal level peaks. To achieve this, a connection may be made at the control console's nemo switch in order to select automatically this *nemo* characteristic for outside programs, causing the unit to act like an ordinary amplifier unless some unreasonably high peak occurs in the program.

The two controlled tubes in this particular unit are 6SA7's, which should be properly balanced for transconductance. Assuming normally good tubes, this balance is readily achieved by means of a balance checking switch and adjusting system. When the balance switch is pressed, a 60-cps signal is applied in phase to the control grids of the 6SA7's, and the balance potentiometer may be adjusted for minimum output meter reading. Balance checks by this means show that ordinary tubes give excellent balance and produce no audible plop or any discernible dissymmetry on an oscilloscope. Furthermore, correct balance produces the condition of minimum harmonic distortion as indicated on a distortion meter.

Above 50 cps, distortion is extremely low, even for conditions of high input levels and gain reduction. Measured curves are shown on *Fig.* 6, and these are representative of ordinary good tubes.

After reaching what was believed to be the stage of complete development, one of these controlled amplifiers was placed in studio operation and used on a great many different N. Y. programs with excellent results. Then a complaint

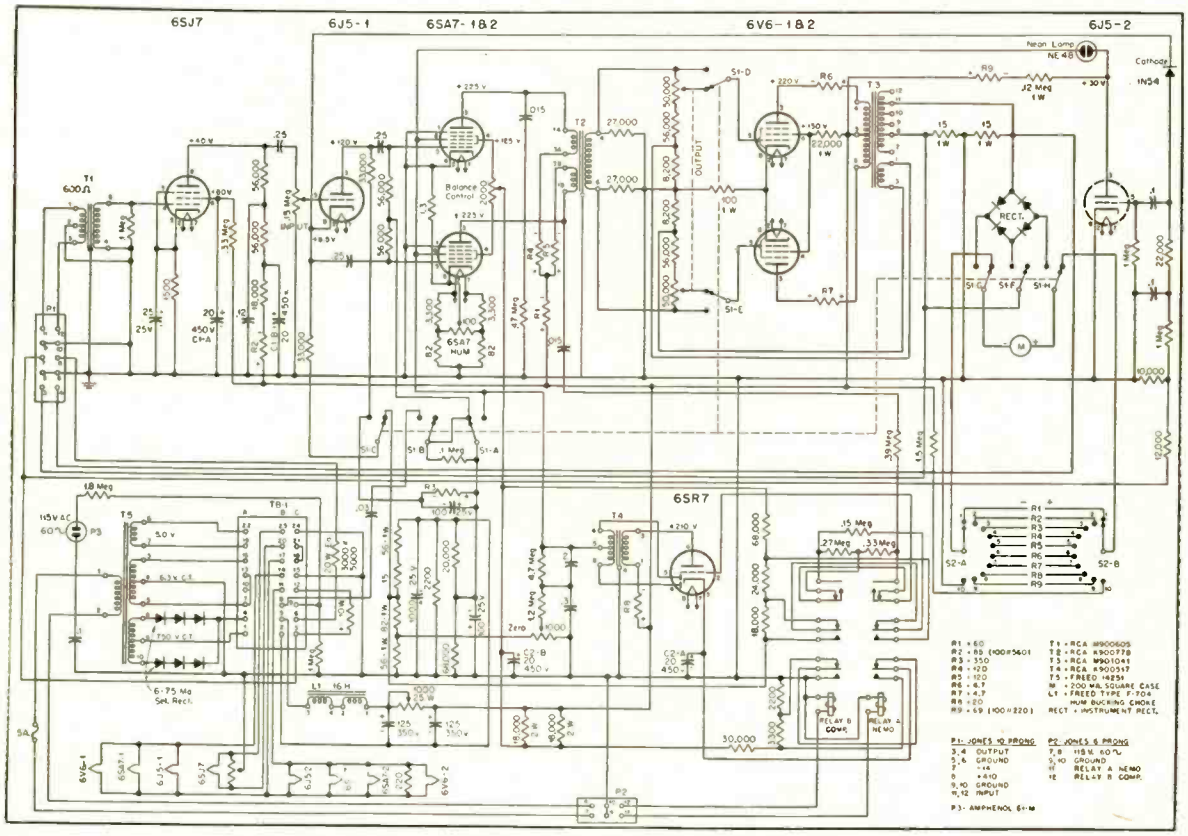


Fig. 7. Complete schematic of ND-333 Automatic Audio Gain Control Amplifier.

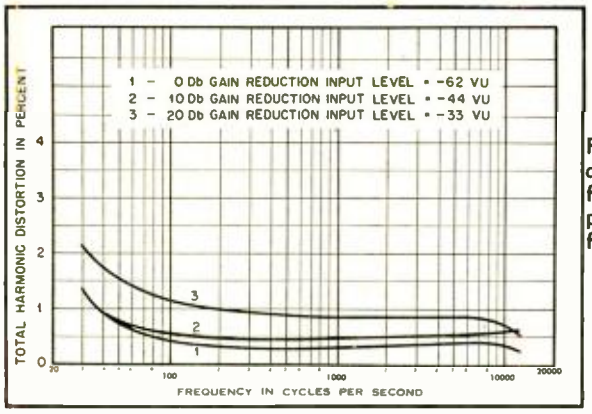


Fig. 6. Harmonic distortion curves for ND-333 amplifier under different operating conditions.

was received which could not be overlooked. The producer on one of the dramatic shows believed that the unit was holding pistol shots down too low in level. He liked its action otherwise but wanted to hear the sound-effect shots louder and have them indicate full scale on the VU meter—the engineer had always been able to achieve this without the automatic control. He agreed that the broadcasting station limiter would reduce most of the excessive peak level but still wanted a more realistic effect in the control and clients booths. Therefore, a short study of pistol shot acoustical characteristics was conducted by viewing oscilloscope patterns. The main portion of the pistol shot proved to be extremely short, in the order of 15 milliseconds. Such a short burst at normal amplitude does not *sound* loud, nor does it *register* fully on a VU meter. In order to make it indicate and sound full, the amplitude must be increased several fold. With this in mind, a special circuit was invented and installed in the unit to create the desired effect. *Figure 7* is a complete schematic of the ND-333 AAGC, showing the pistol shot accentuating circuit at the upper right portion. A crystal rectifier converts a sample of the high-intensity sound potential to a negative d.c. pulse which is coupled to the grid of a triode amplifier. The crystal is biased to conduct only when the input level is 24 db above threshold, a condition existing only on pistol shots as far as we can determine, assuming some degree of manual control. The negative pulse on the grid results in a positive plate pulse, which in turn ignites the neon lamp and momentarily decommissions the control circuit.

ND-333 Application

The new studio control unit is highly effective and multifold in purpose. It permits 6- to 8-db higher average output onto the telephone lines feeding both the local and remote broadcast transmitters. It permits a more even over-all control of level, and unless its action is purposely overridden by the control engineer, makes it unnecessary for millions of listeners to continually jump to adjust the volume controls on millions of radio receivers throughout the country. It gives improved television sound through increased transmission level and uniformity. It prevents excessive levels on telephone long lines, which otherwise cause severe distortion. Broadcasters sometimes feel that the long-lines personnel are supercritical of level. It must not be too high or too low or they call master control to insist on something being done about it. At Radio City some of these AAGC units have been available for just this type of emergency. An engineer on a complicated show may have ten or more microphones to keep properly mixed—a producer shouting instruction, a script to follow, and in addition a PA system to control as well as over-all output level. When "long lines" calls master control and they in turn call this one-armed paper hanger two or three times to bring up level or hold down peaks, he becomes slightly confused. Then, in the deliberate atmosphere of the transmission room, someone says "Here's a rubber amplifier for him," silently inserting patch cords to replace the uncontrolled studio amplifier. Calm returns to the master control room, no more calls come from the supercritical long liners, and in the control booth the operator suddenly has no more trouble delivering a sufficiently high level without the VU meter hitting hard off scale. Above all, thanks to Automatic Audio Gain Control, the listener whose baby sleeps upstairs hears every word of his favorite program without worry of a floor walking session.

In conclusion, a geat deal of credit and thanks should go to Mr. Raymond Lafferty of the NBC Engineering Development Group for his skill and diligence in the development and application of the ND-333.

Employment Register

EMPLOYMENT OPPORTUNITIES 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, Box F, Oceanside, N. Y. before the first of the month preceding the date of issue. Replies to box numbers should be addressed to AUDIO ENGINEERING, 342 Madison Ave., New York 17, N. Y.

★ Positions Open ● Positions Wanted

★ **BRAZIL:** We have an opening for an electronic engineer who would like to come to Brazil and become a partner in an old established high-class service organization. Want man with all around knowledge of receivers, amplifiers, test equipment, electronic heating, and general application of electronics. Capital required, about $5000. São Paulo is the fastest growing city in South America. Genial climate. Food plentiful. Assured future for a good man of about 30. Knowledge of Portuguese not essential. References exchanged. Box 1001.

★ **Wireman,** instrument, capable of building models and occasional short production runs of precision electronic devices. Must be able to work with minimum of supervision. Permanent; write giving salary expected, family status, availability. Box 1002.

★ **WANTED:** Signal Corp Center, Fort Monmouth, N. J. has openings in the following Civil Service positions:

Military Instructors—Microwave relay, radar, radio electronics, fixed station radio, central office techniques, teletype installation and maintenance, repeater and carrier, dial central office maintenance, theory of electricity. $3100–4600.

Electronic Engineers—Participate in design, development, modification, construction, and testing of electronic equipment—radio, radar, wire communications, instrumentation sonar, etc. Responsibility depending upon experience and ability. $3100–6400.

Technical Writers—Write, edit, prepare technical publications, handbooks, circulars, instruction books, etc. Edit and revise scientific manuscripts on radio, radar, electronics, communications, and photography. Write instruction manuals on theory, operation, and maintenance of Signal Corps equipment; determine media and method of presentation of material; prepare charts, graphs, schematic diagrams etc. $3100–5400.

Applicants for any of these positions should write Chief, Civilian Personnel Branch, Signal Corps Center, Fort Monmouth, N. J., submitting a completed Standard Form 57, "Application for Federal Employment" (obtainable at any first or second class post office) for review before going to Fort Monmouth for a personal interview.

AES CONVENTION PROGRAM

COMMENCING AT 10:45 A.M. on October 26th, the Second Annual Convention of the Audio Engineering Society will open at Hotel New Yorker, 34th Street at Eighth Avenue, in New York City, and will feature a series of five technical sessions. All of these sessions will be held in the Grand Ballroom, assuring considerably more space than was available for the meetings in 1949.

Twenty-one full-length papers will be presented at the technical sessions, which will meet on Thursday morning and afternoon, Friday morning and afternoon, and Saturday morning. The opening session is to be devoted to High-Fidelity Sound for the Home, and offers three papers; the Thursday afternoon session and the two on Friday are devoted to miscellaneous audio problems, with the Saturday morning meeting being given over to magnetic recording.

The Second Annual Banquet will be held in the Grand Ballroom on Thursday evening, and will feature the presentation of the Society's Annual Award, the John H. Potts Memorial Award, and a number of Society Fellowships. These presentations will be followed by entertainment.

The complete program for the convention follows:

THURSDAY, October 26, 1950

9:30 a.m. to 6:00 p.m.

Registration .....6th Floor
Audio Fair Exhibits open
5th & 6th Floors
Advance Sale of Banquet Tickets
Room 627

10:15 a.m. to 10:45 a.m.
Business Meeting

Grand Ballroom

Installation of Officers—Committee reports

10:45 a.m. ..... Technical Session

Grand Ballroom

HIGH-FIDELITY SOUND FOR THE HOME
C. G. McPROUD, *Chairman*

1. TOWARD A MORE REALISTIC AUDIO
   ROSS H. SNYDER, *Consultant, Consumers' Research, Inc.*
2. WIDE-RANGE REPRODUCTION
   M. S. CORRINGTON, *Radio Corporation of America*
3. GENERAL PROBLEMS
   NORMAN C. PICKERING, *Pickering & Co.*

12:00 noon to 2:00 p.m. .. Lunch Recess

2:00 p.m. ..... Technical Session

Grand Ballroom

C. J. LEBEL, *Chairman*

STANDARD METHODS OF CALIBRATING DISC RECORDING AND REPRODUCING HEADS
H. E. ROYS, *Radio Corporation of America*

Where response and other characteristics of recording heads and pickups are being specified, it is desirable to have a common method of test so that the results obtained with different types and different manufacture can be compared directly. It is the purpose of this paper to discuss methods of measurement that might be appropriate for such standardization purposes.

Obtaining the frequency-response characteristic of a recording head under no-load conditions (with the stylus vibrating in air) appears to be a logical means of determining the basic response characteristic. Likewise, the response characteristic of a pickup obtained by the variable-speed method also provides a basic measurement.

Additional information is necessary, however, in order to determine the actual operating characteristics since these are so dependent upon the recording medium and the physical characteristics of the stylus, as well as other factors.

2:35 p.m.

SOME APPLICATIONS OF SQUARE-WAVE TESTING TECHNIQUES TO THE EVALUATION OF DISC RECORDING SYSTEMS
SAMUEL R. BRADSHAW and WEIANT WATHEN-DUNN, *Naval Research Laboratory*

Some of the ways in which square waves may be used to determine performance during disc recording and reproducing operations will be discussed, and the inherent limitations of the method will be noted. A practical use of square waves for evaluating overall equalization of recording and reproducing channels on a "yes-no" basis will be described.

3:00 p.m.

R.T.M.A. STANDARDS OF SOUND EQUIPMENT
O. L. ANGEVINE, JR., *Stromberg-Carlson Co.*

R.T.M.A. Standards SE-101A through SE-106 for Commercial Sound Equipment were approved during 1949 after six years of committee work in a field in which no previous standards existed. These standards are reviewed to show their content and to discuss some concepts peculiar to sound equipment. Among these are the 70-volt standard for speaker lines and the matching of speakers to amplifiers by the use of voltage and power ratings, the measurement of speakers using a source having a 3-db voltage regulation, and the use of "transducer gain" as the gain of an amplifier.

A new "Loudness Efficiency" and a "pressure Efficiency" are used for rating speakers, and a new method for rating sensitivity of microphones is introduced. The body of standards is so integrated that the sensitivity of the microphones, the gain of the amplifier, and the efficiency of the speaker can be added to get a system rating.

The new standards will be followed in the next catalogues of most sound equipment manufacturers and should eliminate the present confusion as to the meanings of ratings.

3:45 p.m.

EDUCATIONAL AUDIO REQUIREMENTS
PROFESSOR WILLIAM J. TEMPLE, *Brooklyn College*

Educational needs are not always met adequately by audio equipment designed primarily for other applications and only incidentally for the uses of the teaching profession. Features which are desirable in equipment for communications or entertainment may be disadvantages in certain classroom uses. Special areas in the fields of speech and language instruction call for recording and reproduction of very high quality. Teachers are learning to analyze their needs and appraise these new tools of their trade functionally in terms of essential features, desirable refinements, and meretricious gadgetry.

4:20 p.m.

TEST AND DEMONSTRATION RECORDS
An AES Committee Report; R. D. Darrell, *Chairman.*

7:00 p.m. SECOND ANNUAL BANQUET

Grand Ballroom

COL. R. H. RANGER, *Toastmaster*
Presentations: Society Annual Award, the John H. Potts Memorial Award, and Society Fellowships

FRIDAY, October 27, 1950

9:30 a.m. to 9:00 p.m.

Registration .....6th Floor
Audio Fair Exhibits ..5th & 6th Floors

9:30 a.m. ..... Technical Session

Grand Ballroom

JOHN D. COLVIN, *Chairman*

LOW-NOISE MINIATURE PENTODE FOR AUDIO AMPLIFIER SERVICE
R. A. WISSOLIK and D. P. HEACOCK, *Radio Corporation of America*

The RCA-5879, which was designed for audio applications requiring a miniature tube having reduced noise, is described. The design features which account for the improved microphonics level, the low hum, and the reduced leakage noise in this single-ended, 9-pin miniature pentode are discussed. Data are presented to compare the performance of the 5879 tube with other tubes used in similar applications.

10:05 a.m.

A CONSIDERATION OF THE INTENSITY-LOUDNESS FUNCTION AND ITS BEARING UPON THE JUDGMENT OF "TONAL RANGE" AND "VOLUME LEVEL"
STEPHEN E. STUNTZ, *U. S. Naval Medical Research Laboratory*

Acoustical intensity not only affects the loudness of sounds, but also profoundly influences the listener's perception of certain ranges of frequencies. The data of Fletcher and Munson demonstrate that the effective frequency response of the ear varies with signal intensity-level. On the basis of this variation, it is possible to account for certain anomalies appearing in the Eisenberg and Chinn study of listeners' preference for frequency ranges and intensity levels in the reproduction of speech and music. It is also possible to explain the disparity between their results and those of Olson's investigation of preference for frequency ranges. For example, it can be shown that when frequency is plotted against loudness, raising the intensity level from 50 to 70 db will add more than one whole octave downward to the effective frequency response of the ear at 50 millisones loudness.

10:40 a.m.

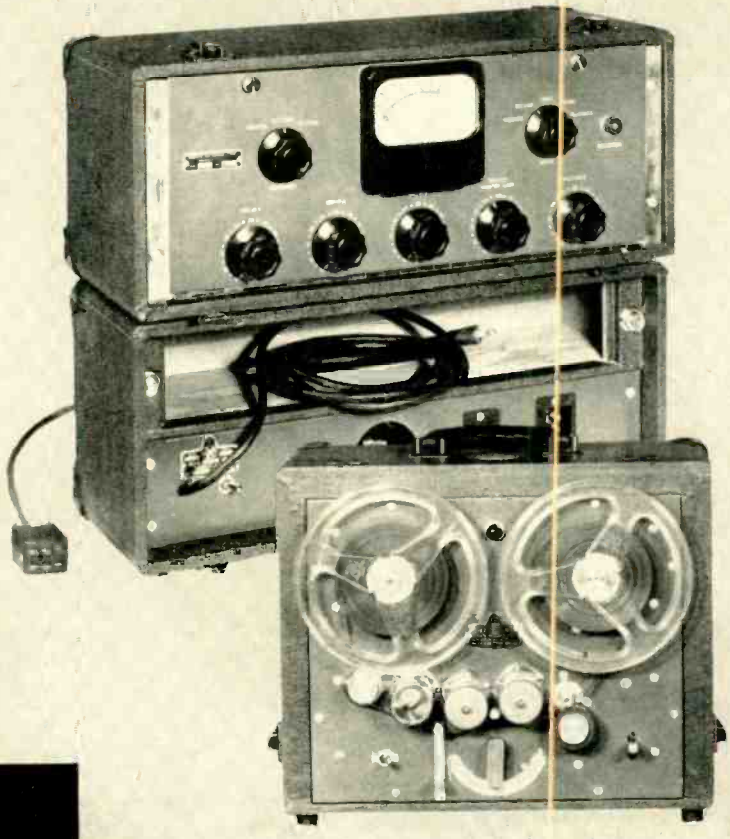
CBS TELEVISION STUDIO INTER-

[*Continued on page 48*]

the

PRESTO PT-900

America's finest portable tape recorder



Look at these features:

- Three heads for recording, playback, erasing.
- Separate recording and monitoring amplifiers.
- Three microphone input.
- Speeds: 15" and 7½"/sec.
- Frequency response: 50-15,000 cps.
- Power supply and amplifier in separate, leatherette covered cases.

The PRESTO PT-900 has been chosen by discriminating engineers, educators and broadcasters throughout the country as the best constructed, best performing, most durable, portable tape recorder available today. Combining the features of machines costing hundreds of dollars more, the PT-900 answers the need for a recorder of ultra-high fidelity in a completely portable, compactly designed unit. Built by the world's largest manufacturer of recording equipment and discs, the PRESTO PT-900 is precision engineered for years of satisfying service.

PRESTO RECORDING CORPORATION
Paramus, New Jersey

In Canada: Walter P. Downs, Ltd., Dominion Square Bldg., Montreal, Canada
Overseas: M. Simons & Son Co., Inc., 25 Warren Street, New York, N. Y.

THE AUDIO FAIR — 1950

Directory of Exhibitors

The largest exhibition of audio equipment ever assembled under one roof opens Thursday, October 26th at 9:30 a.m. on the fifth and sixth floors of Hotel New Yorker, with a total value of displays well in excess of a quarter of a million dollars. Visitors to the first Audio Fair will remember that all records were broken—an attendance of over three thousand at the Convention and exhibit of a Society with a membership at that time of less than one thousand.

The entire sixth floor is occupied with the displays of forty-three exhibitors, and fifteen rooms on the fifth floor are taken at the time of going to press. This represents an increase of approximately fifty per cent over the first Fair, and provides considerably more space for the visitors—particularly since many of the exhibitors have increased their space appreciably.

Newcomers to the second Audio Fair include Gates Radio Company, Tetrad, FM & TV Magazine, United Transformer Company, Audio-Master, Browning, Bell Sound Systems, Inc., Measurements Corp., Herman Hosmer Scott, Inc., Triad Transformer, Fisher Radio, Radio & Television News, Electronics of Staten Island, The Langevin Company, and Cinema Engineering Company. The jobbers exhibiting at the 1950 Audio Fair include: Sun Radio, Harrison, Midway, Sonocraft, Terminal, Harvey, Hudson, Milo, Arrow, and Leonard Radio, ensuring a wide variety of radio and electronic components in addition to the products of the manufacturers who are exhibiting in their own rooms.

The Audio Fair only lasts for three days—including one evening—and then a whole year elapses until the next one. To make sure of seeing everything in the audio field, come early and often, but be sure and *Come to the Fair.*

ALTEC LANSING CORPORATION 618–619
Hollywood, California
161 Sixth Ave., New York
Products: Speakers, microphones, tweeters, AM-FM tuners, home music systems.

IN ATTENDANCE
H. S. Morris — Dave Sonkin
Mel Sprinkle — Marty Wolf

AMPEX ELECTRIC CORPORATION 614–615
San Carlos, California
Products: Ampex Tape Recorders.

IN ATTENDANCE
Charles E. Rynd — Russell O. Hudson
W. O. Summerlin

AMPLIFIER CORP. OF AMERICA 531
396–398 Broadway, New York
Products: Magnetic tape recorders, high-fidelity phono amplifiers; electrical test equipment.

IN ATTENDANCE
N. M. Haynes, *Chief Engr.*
M. R. Ellis
P. H. Frankel
R. Epstein
Sidney Karr
Ph. Kootman
Frank Kosinski

ARROW ELECTRONICS 646
82 Cortlandt St., New York
Products: Lowther-English speakers; Sonar Radio Corp. equipment; Audio Labs of Phoenix, Arizona; amplifiers, speakers, pick-ups, and audio equipment.

IN ATTENDANCE
Murray Goldberg, *Pres.*
Charles Ray, *Sound Dept. Mgr.*
Jack Kirshbaum
Emery Jusztus, *England*
Jack Babkes

AUDAK COMPANY, INC. 642–643
500 Fifth Avenue, New York
Products: Electronic reproducers; Polyphase and Tuned Ribbon pickups; recording cutters.

IN ATTENDANCE
Maxmillan Weil, *Pres.*
A. Weberg, *Technician*
J. V. Sullivan, *Vice Pres.*

AUDIO DEVICES, INC. 651
444 Madison Ave., New York
Products: Audiodiscs (recording discs); Audiopoints (recording and playback styli); Audiotape (magnetic recording tape).

IN ATTENDANCE
William C. Speed, *Pres.*
Bryce Haynes, *Vice Pres.*
C. J. LeBel, *Vice Pres.*
Herman Kornbrodt, *Regional Sales Mgr.*

AUDIO FACILITIES CORPORATION 647
133 W. 14th St., New York
Products: Artificial Reverberation Generator (Represented by Tech Laboratories, Inc.)

IN ATTENDANCE
M. Bjorndahl — E. Bjorndahl
G. Van Baaren — A. L. Budd
G. Harris — W. Richards
K. Meri

AUDIO INSTRUMENT COMPANY 630
133 W. 14th St., New York
Products: Intermodulation sets, Bridgers, Disc-Noise meters, Logarithmic amplifiers, condenser microphone preamplifiers, microphone equalizers.

IN ATTENDANCE
C. J. LeBel, *Chief Engr.*
A. C. Hendricksen
F. M. Conte

THE AUDIO-MASTER COMPANY 644
23 W. 45th St., New York
Products: Recording equipment, microphones, playback machines.

IN ATTENDANCE
Herbert Rosen

AUDIO & VIDEO PRODUCTS CORP. 614–615
1650 Broadway, New York
Products: Ampex tape recorders.

IN ATTENDANCE
Charles E. Rynd, *Pres.*
W. Oliver Summerlin, *Vice Pres., Engr.*
Russel O. Hudson, *Vice Pres.*
Kenneth B. Boothe, *Eastern Sales Mgr.*

BALLENTINE LABORATORIES, INC. 526
Boonton, N. J.
Products: Electronic voltmeters.

IN ATTENDANCE
Charles L. Gawler — Walter A. Knoop
Harry C. Gawler — Allyn W. Janes

BELL SOUND SYSTEMS, INC. 648
555 Marion Road, Columbus, Ohio
Products: Hi-fidelity amplifier, tape recorders, and other allied equipment.

IN ATTENDANCE
Floyd W. Bell, *Pres.*
H. H. "Pete" Seay, Jr., *Vice Pres. & Gen'l. Mgr.*
L. Evans, *Engr.*
E. Sisson, *Chief Engr.*

BERLANT ASSOCIATES 529
4917 W. Jefferson Blvd., Los Angeles, Calif.
Products: Concertone magnetic tape recorder.

IN ATTENDANCE
Emanuel Berlant — Avery R. Fisher

BRITISH INDUSTRIES CORP. 650
164 Duane St., New York
Products: Garrard record changers; Leak "Point One" amplifiers; Wharfedale speakers.

IN ATTENDANCE
Leonard Cardiner, *Pres.*
G. A. Briggs
Frank Hoffman
Eugene Cardiner
H. J. Leak
Wm. Lichter

BROWNING LABORATORIES, INC. 645
750 Main St., Winchester, Mass.
Products: Tuners—FM and AM-FM.

IN ATTENDANCE
Glenn H. Browning, *Pres.*
S. S. Egert, *Representative*
John Mandel, *Representative*
Ralph L. Purrington, *Vice Pres.*
J. Fields, *Representative*

BRUSH DEVELOPMENT CO. 649
(Burlingame Associates, 103 Lafayette St., New York)
Products: Soundmirror magnetic tape recorders.

IN ATTENDANCE
J. H. Munchausen — B. O. Burlingame

BURLINGAME ASSOCIATES 649
103 Lafayette St., New York
Products: Hewlett-Packard audio test equipment; Brush Development Co. instruments; Tektranics, Inc. Oscilloscopes.

IN ATTENDANCE
Bruce O. Burlingame
A. J. Novak, *Brush Dev. Co.*
Roland Reisley, *Engineer*
Jack Grand
M. J. Lichtenstein, *Field Engr.*
Robert Asen, *Field Engr.*

[*Continued on page 42*]

New 1951 • • MODEL V-4A

Heathkit VTVM KIT

HAS EVERY EXPENSIVE *Feature*

- ★ Higher AC input impedance, (greater than 1 megohm at 1000 cycles).
- ★ New AC voltmeter flat within 1 db 20 cycles to 2 megacycles (600 ohm source).
- ★ New accessory probe (extra) extends DC range to 30,000 Volts.
- ★ New high quality Simpson 200 microampere meter.
- ★ New ½% voltage divider resistors (finest available).
- ★ 24 Complete ranges.
- ★ Low voltage range 3 Volts full scale (⅓ of scale per volt).
- ★ Crystal probe (extra) extends RF range to 250 megacycles.
- ★ Modern push-pull electronic voltmeter on both AC and DC.
- ★ Completely transformer operated isolated from line for safety.
- ★ Largest scale available on streamline 4½ inch meter.
- ★ Burn-out proof meter circuit.
- ★ Isolated probe for dynamic testing no circuit loading.
- ★ New simplified switches for easy assembly.

New LOW PRICE **$23.50**

The new Heathkit Model V-4A VTVM Kit measures to 30,000 Volts DC and 250 megacycles with accessory probes — think of it, all in one electronic instrument more useful than ever before. The AC voltmeter is so flat and extended in its response it eliminates the need for separate expensive AC VTVM's. + or — db from 20 cycles to 2 megacycles. Meter has decibel ranges for direct reading. New zero center on meter scale for quick FM alignment.

There are six complete ranges for each function. Four functions give total of 24 ranges. The 3 Volt range allows 33⅓% of the scale for reading one volt as against only 20% of the scale on 5 Volt types.

The ranges decade for quick reading.

New ½% ceramic precision are the most accurate commercial resistors available — you find the same make and quality in the finest laboratory equipment selling for thousands of dollars. The entire voltage divider decade uses these ½% resistors.

New 200 microampere 4½" streamline meter with Simpson quality movement. Five times as sensitive as commonly used 1 MA meters.

Shatterproof plastic meter face for maximum protection.

Both AC and DC voltmeter use push-pull electronic voltmeter circuit with *burn-out* proof meter circuit.

Electronic ohmmeter circuit measures resistance over the amazing range of 1/10 ohm to one billion ohms all with internal 3 Volt battery. Ohmmeter batteries mount on the chassis in snap-in mounting for easy replacement.

Voltage ranges are full scale 3 Volts, 10 Volts, 30 Volts, 100 Volts, 300 Volts, 1000 Volts. Complete decading coverage without gaps.

The DC probe is isolated for dynamic measurements. Negligible circuit loading. Gets the accurate reading without disturbing the operation of the instrument under test. Kit comes complete, cabinet, transformer, Simpson meter, test leads, complete assembly and instruction manual. Compare it with all others and you will buy a Heathkit. Model V-4A. Shipping Wt., 8 lbs. Note new low price, $23.50.

New 30,000 VOLT DC PROBE KIT

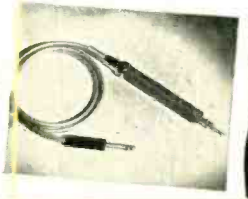
Beautiful new red and black plastic high voltage probe. Increases input resistance to 1100 megohms, reads 30,000 Volts on 300 Volt range. High input impedance for minimum loading of weak television voltages. Has large plastic insulator rings between handle and point for maximum safety. Comes complete with PL55 type plug.

No. 3366 High Voltage Probe Kit. Shipping Wt., 2 pounds. **$5.50**

Heathkit RF PROBE KIT

Crystal diode probe kit extends range to 250 megacycles ± 10% comes complete with all parts, crystal, cable and PL55 type plug.

No. 309 RF Probe Kit. Shipping Wt., 1 lb. **$5.50**



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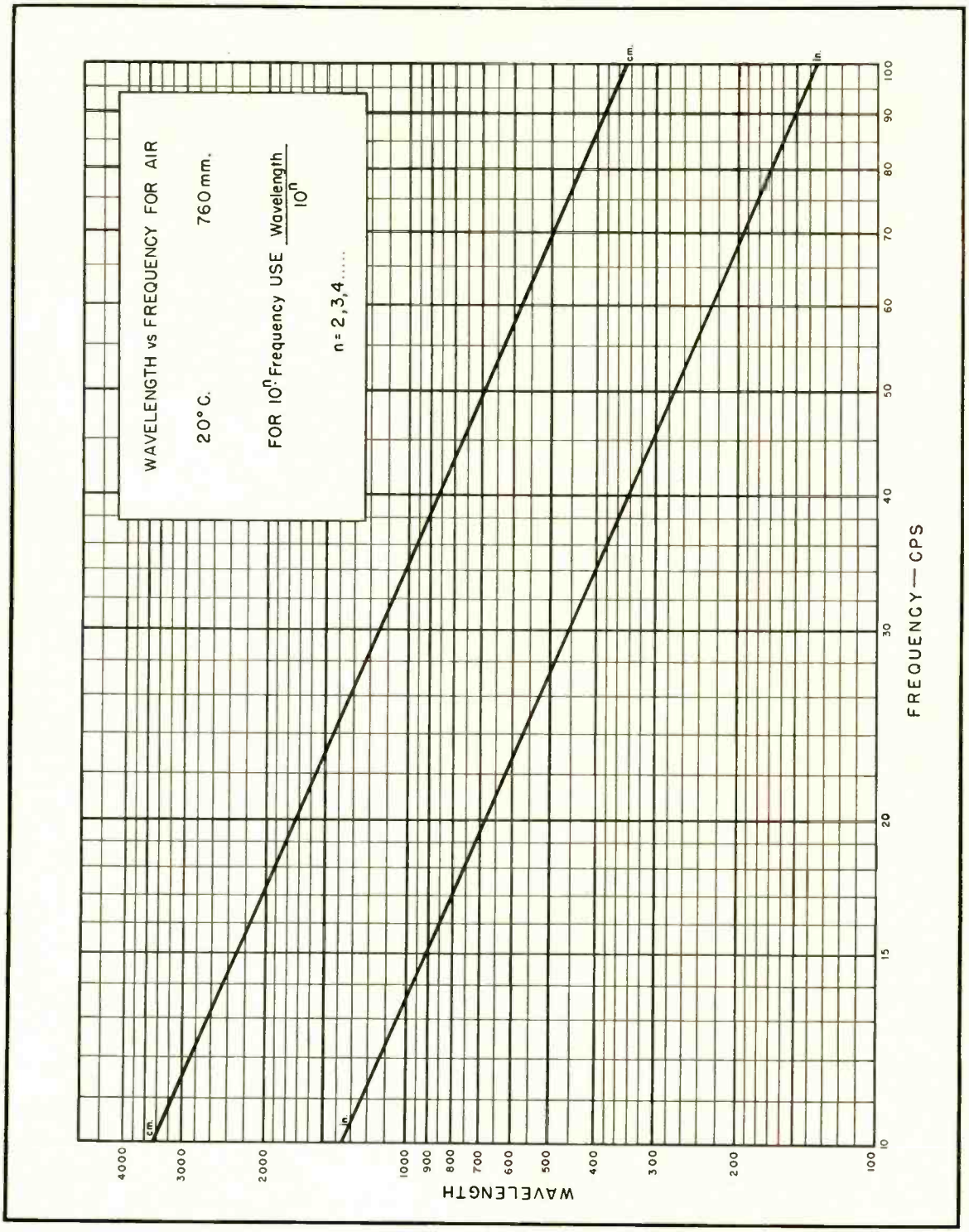
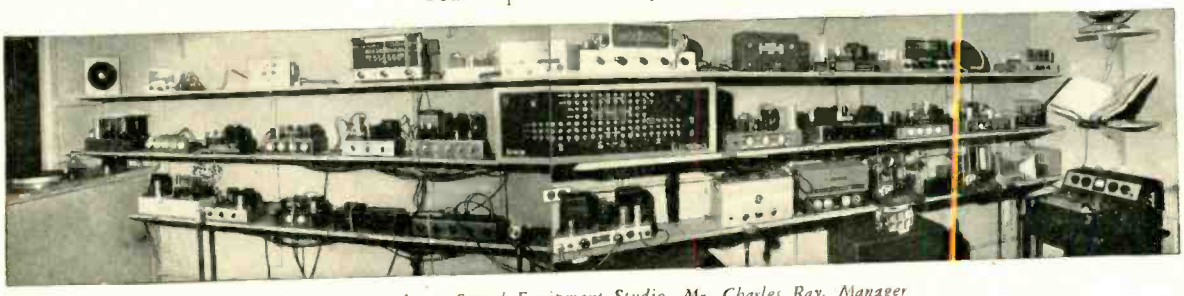
AUDIO DESIGN NOTES

CHART SHOWING WAVELENGTH FOR AIR



Beauty in Sound

. . . is the ultimate in
natural and precise reproduction obtained by
laboratory tested equipment in the
ARROW ELECTRONICS Sound Department.
Your inspection is always invited.



Partial view of our Sound Equipment Studio. Mr. Charles Ray, Manager

THE LOWTHER  **DRIVER UNIT**

The Lowther Driver Unit, used with
the Voigt Horn is the world's most precise sound system. Only those who hear its unsurpassed
accoustical efficiency can believe its phenomenal presence effect.
Specifications — Flux Density: 19,500 gauss average over gap area.
Weight: 19 lbs. (average). Dimensions: 8½" high, 8" wide, 7½" deep.
Dynamic Impedance: 15 ohms. Frequency Response: 18 to 20,000 cps.

SONAR  **RECORDER**

The Sonar is a single case tape recorder and playback.
Precision made, it is geared for perfect reproduction, rugged wear, and a variety of uses.
Specifications — Power Input: 110-120 v 60 c, 80 w. Input Level: Microphone from —60 D.B.
Bridge —10 to ± 10 D.B. based on .006 M.W. ref. Output: Balanced or unbalanced 600 ohm line O
D.B. or ± 8 DBM to an H Pad. .006 M.W. ref. Frequency Response: 7.5" per sec. 35 to 10,000 c ±
2.75 D.B. with less than 2% total harmonic distortion. Amplifier Response: 20 to 20,000 CPS
± 2 D.B. O D.B. level output less than 2% total harmonic distortion.
Playing Time: 7" reel 1,250' of tape, 33 min sgle track 7.5" per sec. 10¼" reel, 2,500', 66 min.

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to the ARROW ELECTRONICS display at
the Audio Fair, at Hotel New Yorker, October 26-28, 1950.
Audio equipment of the very
latest technical design will be on display, including the Sonar Tape Recorder
and the Lowther-Voigt Reproducer.

We are one of the East's largest
distributors of the widest range of electronic parts and components—
representing the country's most reputable manufacturers.
Trained practical technicians, large warehouse stocks,
and overnight delivery in the Metropolitan area,
assure you quick, accurate and *friendly* service.

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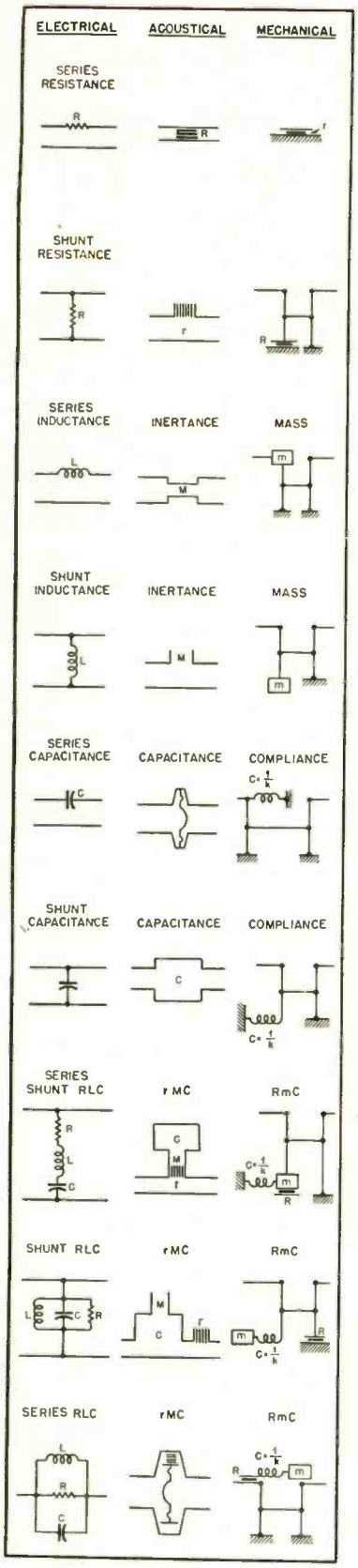

AUDIANA

Dynamical Analogies

Part II

LEWIS S. GOODFRIEND

A HANDY CHART of the analogous elements in the three systems (rotational motion cases are not presented because of their scarcity in audio) is presented at the left. In each of the mechanical figures the joints, unless otherwise indicated, are pins. Also in all cases the perturbing forces are considered small, so that it in no case in any classic limit exceeded nor is it ever necessary to consider second order effects.

It should also be noted that there is no exact acoustical analogy for series capacitance, and use is made of a diaphram of small mass and high stiffness working well below its resonant frequency. The acoustical capacitance of the system is then $C_A = C_M S^2$ which shows that the system is stiffness (k) controlled since $C_A = \frac{1}{k}$. To compare it with the electrical case it can be seen that a direct current cannot be transmitted by a capacitor nor in this analogy can a change in pressure be transmitted from one side of the diaphram to the other.

One of the important requisites in the use of the analogies is the use of appropriate units. All electrical units must be expressed as absolute units in which the following relationships hold:

abohms = $10^9 \times$ ohms
abvolts = $10^8 \times$ volts
abamps = $10^{-1} \times$ amps.

The use of different units within any given system is permissible, but it is not practical when working continuously with analogies because it creates confusion.

Loudspeaker Baffles

Figure 3 shows a loudspeaker and several baffles or boxes, together with their electro-mechanical analogies. Examining the circuit of the speaker in the infinite baffle it can be seen that the resonant frequency of the system is determined by the compliance of suspension and the masses of the cone, voice coil, and airload. This gives the following relation for resonance:

$$X_{MA} + X_{MC} = X_{MS}$$

where $X_{MS} = \frac{1}{\omega C_M}$, reactance due to compliance of mounting of cone.

$X_{MC} = \omega m_C$, reactance of mass of cone and voice coil.

$X_{MA} = \omega m_A$, reactance of air load on cone.

$m_A = 1.72 \pi \rho R^3$, where $2R < \lambda$

For the second case, the enclosed box baffle, there is an additional reactance supplied by the compliance of air in the cabinet, which is in series with the suspension compliance. These compliances are combined in the same manner as series capacitances in an electrical circuit, and thus the total compliance is lower than in the previous case. The expression that must hold for resonance is now:

$$X_{MA} + X_{MC} = X_{MS} + X_{MV}$$

Where

$$X_{MV} = \frac{S_c^2 \rho c^2}{\omega V}$$

is the reactance due to the compliance of the enclosed air volume, cm³.

S_c = area of the cone, cm².
ρ = density of air, gm/cm³ (0.0012)
c = velocity of sound, 34,400 cm/sec.

With this new lower value of compliance, the resonant frequency of the system is raised. However, if a high-quality loudspeaker having a low-resonant-frequency mechanism is used in a baffle or open-backed box of practical size, the response will be curtailed at the low end by the cancellation below the doublet transition. While the same speaker in an enclosed box will have a slightly higher resonant frequency, the overall response is likely to be better. To achieve the same results in a flat baffle

[*Continued on page 61*]

We agree that it's hard to believe, but here it is in the amazing new

FLEWELLING AUDIO SYSTEM

ONE expert after another has listened to the Flewelling Audio System and summarized its performance as the greatest advance in sound reproduction since the days when headphones and mechanical phonographs were superseded by loudspeakers and electrical pickups.

More than five years were spent on the perfection of this system by the inventor, E. T. Flewelling. He has this to say about it: "I have never made any claims for this system, because audio reproduction is something very personal to each listener. However, some five hundred experts have listened to installations of this design, and all agree that it is the most realistic and enjoyable reproduction they have ever heard."

Here are typical comments (with explanatory notes) made by those who have listened to the Flewelling Audio System, but were not given technical information on its design:

BROADCAST ENGINEER: "You must use 150 watts at the low-frequency end to get such a tremendous effect from the drums!" (Maximum output is less than 5 watts)

AUDIO CONSULTANT: "I'm satisfied that the only speakers in this room are the 8-in. and tweeter speakers set up on plain baffles, but it's impossible for them to deliver the quality that I am hearing!" (There's more to the FAS than meets the eye)

MUSIC CRITIC: "I can feel the vibration from low organ notes, just as I do in the big churches!" (Yes, that's quite true, even down to 32-ft. pipes) "And I still feel those low notes with the volume down almost to the limit of audibility!" (True again. There's a feeling of vibration in the air, and in the floor, too)

AUDIO ENGINEER: "It sounds to me as if you have invented a new type of speaker with a flat efficiency characteristic down to 27 cycles, or an amplifier which increases enormously in output at the low end. But you tell me that you are using only a pair of 6L6's!" (Only conventional, low-priced speakers are used, and standard audio components)

VIOLINIST: "This is the first time I have heard reproduction when I could distinguish between a violin and a viola!" (That realism, plus a truly amazing presence effect, are characteristic of the FAS)

RADIO MANUFACTURER: "This is luxury performance. Few people can afford such installations!" (The cost is as surprisingly low as quality is high)

ORCHESTRA CONDUCTOR: "I have always tired quickly of listening to radio and phonograph music, but I have listened to this all evening!" (There seems to be no fatigue-factor in the FAS)

CUSTOM DESIGNER: "I can sell any number of jobs like this. How long before I'll be able to get the parts necessary?" (They are available now from any parts jobber.)

Here's how you can find out all the things that those people weren't told when they listened to the FAS:

The details of the Flewelling Audio System will be disclosed in a series of exclusive articles in *FM-TV* Magazine, starting with the October issue. We do not hesitate to promise that you will find Mr. Flewelling's disclosure of his invention, and his discussion of radio-phonograph reproduction the most interesting and intriguing series ever written on any audio subject.

These articles will open up unlimited possibilities for completely new designs for radio-phonograph installations, and endless experiments with tuners, pick-ups, amplifiers, and speakers. First, however, Mr. Flewelling will present the exact details of the design he is using for demonstration purposes.

Because *FM TV* Magazine is sold only by subscription, our supply of extra, single copies is very limited. Moreover, the articles on the Flewelling Audio System will run for more than six months. Accordingly, since you will want the complete series, we urge that you enter a year's subscription to start with October. The first issue will be worth the subscription price!

HEAR THIS SYSTEM

It will be demonstrated at our display in Room 638 at the Audio Fair. Bring your own records, and check the quality of reproduction.

GET COMPLETE DATA

Send your subscription order at once, so you will not miss the first article of this series, starting in October.

FM-TV Magazine
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Great Barrington, Mass.

Please enter my subscription, starting with the October issue, so that I will have the complete series on the Flewelling Audio System. I enclose:

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FM-TV MAGAZINE

Published by Milton B. Sleeper

Bank Building Great Barrington Massachusetts

EDWARD TATNALL CANBY

Mr. Canby presents a regular program of "New Recordings" on New York City's Own Stations, WNYC (830 kc) and WNYC-FM (93.9 mc), each Sunday at 1:00 P.M.

To the New Subscriber

IT'S BEEN A LONG three and a quarter years of expansion since this magazine and this column began their joint existence, the latter under the somewhat misleading title of RECORD REVUE. We have picked up a lot of subscribers since these early days, and by simple arithmetic, or something, it seems obvious that the same gentry—those who have not read early issues of Æ—may now be wondering how a Record Revue ever got to be this way, with a lengthy disquisition at the beginning which only once in a while ties itself directly to records—and sometimes not even any record reviews at all, as happened unavoidably in the July issue.

It's not that we don't intend to cover records as adequately as possible under the present dizzy conditions of runaway LP. (The new experimental policy of more records and shorter reviews goes into effect herewith.) The present Canby department (and the Globus similarly) is in effect two departments—one a Record Revue and the other an article which, since neither the editor nor I has ever been able or willing to figure out a separate name for it, simply gets stuck under the convenient Record Revue head! Confusing for the new subscriber maybe, but after an issue or so you'll get the idea—just overlook RECORD REVUE for Part I and apply it to Part II, which *is* a review of records.

Preliminary Article

And the why and wherefore of the preliminary article? It seems to have grown more or less out of inner necessity. Inner, as far as this writer is concerned, and inner as far as a good slice of the readership is concerned, too. The rest of this magazine is devoted, as it should be, to competent articles in a technical field by recognized trained technicians in that field. In any other periodical of the sort, in any other area, that would be the end of it, and rightly. This is a technical magazine.

But the audio field is perhaps unique in that the product—the final product—of all its labors is intelligible sound. Moreover, willy-nilly, a large percentage of that final product is in the form of music, not speech. Audio therefore has the doubtful distinction of existing linked inseparably to an art that in most people's minds is about as far removed from engineering as anything human could be. (I, for one, am ready to deny this violently, but let it ride for the moment . . .) Moreover, audio gets itself involved at every turn with other major fields of endeavor. The listening process, which is the human activity that, in the end, is the final judge of all audio, get us enormously involved in the most advanced psychology; for listening is one of the more subtly difficult things to analyze that the psychologist has in his repertoire. Physiology, too, comes along with audio, for it is the combination of physical reactions and mental ones that makes listening possible . . . but enough said.

Given all of this, and given the intelligent engineer and near-engineer who reads this sheet, given the present writer who happens to be much interested in all of this—a RECORD REVUE in a somewhat wider sense than the title implied was inevitable. Records have a fine way of bringing to a head practically all of the problems that involve audio with its other linked fields. Maybe you can just review records (i.e. talk about the music on them and the performance) and go no further, in any other sort of magazine, but not here! That would be impossible.

Committee of Ph.D.'s

So one thing led to another, as they say . . . and we now come to a final aspect of the present Record Revue-plus-general-discussion. Theoretically, in order to discuss relations between music, psychology, biology *et al*, one should require a super-genius with a Ph.D. in at least each of those fields with (natch) a degree in electronic engi-

[*Continued on page 55*]

* *279 West 4th Street, New York 14, N. Y.*

Pops

RUDO S. GLOBUS*

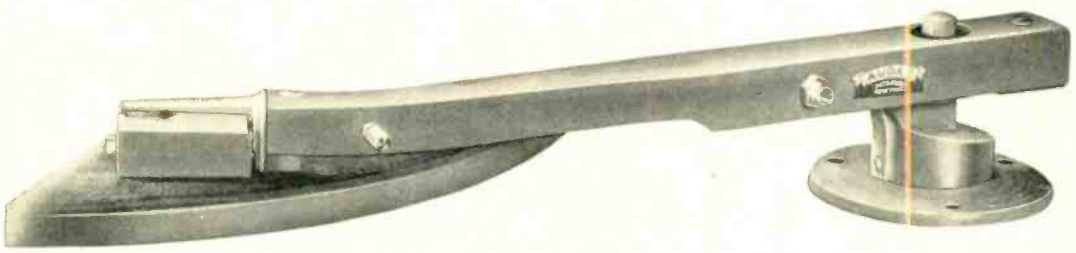
A FEW MONTHS AGO I promised to run a list of pop "classics," based on availability and agreement with conditions already laid down in this column. Something has been going on for the past several weeks which gives priority to this month's column over anything and everything else. Therefore, this month's column will temporarily leave its predestined boundary lines and deal with a situation which affects every possible kind of music.

For the past few years, the music business has been at low ebb. So far, the layman has had no opportunity either to affect or to be affected by the situation. The climatic events of the past six or seven weeks have radically changed the focus of the crisis, and from this point on in, you and I and everybody in any way connected with or interested in music are in the battle. In a certain sense, you and I are responsible for the situation, although it would be blatantly stupid to put more than a partial share on our shoulders.

The situation that led up to the recent catastrophe amounted to something like this: A combination of poor business management and overpopulation resulted in a steady rise in the unemployment of musicians. The death of the dance band after the war, the enormous cut in radio, theatre and night club use of live music, the agonizing suicide of innumerable symphony orchestras throughout the country created a wolf pack of musicians, roaming restlessly through the major centers of American musical activity. Unlike the usual labor shifts that can be expected in other occupational groups, the musician refused to change profession. With the yearly influx of bright-eyed, glamour struck, and naive young musicians into New York, Chicago, and Los Angeles, the situation steadily worsened. In a city with a musical popula-

[*Continued on page 51*]

* *960 Park Ave., New York 28, N. Y.*

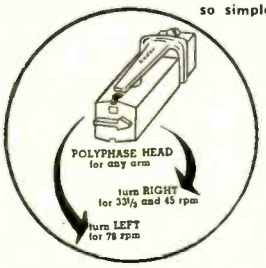


*HANGOVER

From a letter ". . . . The first thing that struck me about my L-6 POLYPHASE was the total absence of that strident harshness which has come to be accepted as unavoidable in reproduced music. When played in direct comparison with my . . . . , which, I admit, I bought because of the high cycles claimed for it, POLYPHASE is truly a revelation. It is the cleanest, smoothest instrument I have ever heard. If there be many others who, like me, have gained the idea that mere kilocycles and high-fidelity (faithfulness) are synonymous, then the electronic industry is to blame. For me, all that is water over the dam; I am peeved at no one. My L-6 POLYPHASE more than makes up for everything. I look forward to reading your next 'HANGOVER' . . . . . "

Precisely what we've cautioned against! Wide frequency range alone does not produce EAR-QUALITY. Of all the other factors, the most important is reduction of Vibratory-Momentum to near zero. The nearer the vibrating mass to the zero ideal, the less the "HANGOVER" and the finer the finished performance.

The vibrating mass in POLYPHASE is tinier, by far, than in any other pickup hitherto devised. And . . . . POLYPHASE costs less.



- One single high quality magnetic unit and same point pressure for all discs—6–8 grams.
- Sapphire styli (or diamond) replaceable individually, as simply as you replaced steel needles.
- Output about 20 m.v.
- Response 20 to over 10,000 cps.
- **Needle-talk practically nil.**
- Tracking phenomenal.
- High or low impedance.
- Flexible plug-in connectors.
- Available for GARRARD, WEBSTER and other changers. (high-output model for Webster Changers.)

There's an Audax for every purpose . . . including Vertical-Lateral models.

See it and HEAR it at the Audio Fair

* ugly form of distortion

The Audax ARM . . . SIMPLICITY *itself!*

- Only 3 parts
- Highest tracking efficiency
- No restraint to stylus travel
- Frontal oscillations nil
- No springs
- No fatigue
- Maintains original point-pressure permanently—regardless of climatic changes
- Unquestionably the simplest and most efficient arm yet devised.

in 12 inch and 16 inch models

and Audak arms cost less

Never before such **EAR QUALITY**, such **FAITHFUL** reproduction . . . that is **POLYPHASE**

but...

ONLY YOU can decide what sounds best and most pleasing to your ears. Therefore . . . . see it, HEAR it, and compare it with any reproducer at any price . . . . then, you be the judge

— ***Send for editorial reprint on POLYPHASE principles.*** —

AUDAK COMPANY

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"Creators of Fine Electro-acoustical Apparatus for over 30 years"

A Controversial Idea from England

P. G. A. H. VOIGT*

AS A RADIO EXPERIMENTER with a brand new degree in 1922, I joined Messrs. J. E. Hough Ltd., then making mouldings for the wireless trade and wishing to go into the wireless business on their own account.

As that firm had long previously taken over the old British Edison Bell Company and were busy making Edison Bell "Winner" and "Velvet Face" gramophone records, readers of AUDIO ENGINEERING will understand why I developed a very rapid interest in the recording of master waxes, and why I decided something had better be "done" about the horn recording system then in use.

While it was obvious that any electrically aided recording system would involve the basic items of microphone, amplifier, and cutter, I like, when it is possible, to go beyond the surface of things and consider fundamental factors. So the fundamental question of "what would perfect sound reproduction sound like?" was pondered over.

On enquiry from the experts I found that a "forward" tone was apparently the ideal of the gramophone designer.

Now, having some scientific knowledge, I could not quite understand how a mechanical instrument could be expected to produce a tone which would appear to originate at some point 6 inches, 12 inches, or so in

FINE FORWARD TONE

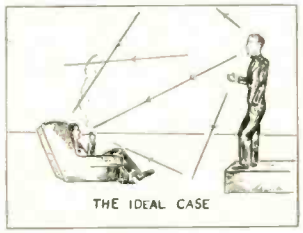
front of the mouth of the horn, unless this effect were achieved by resonance or some form of forward reflection which would give a focal point there.

The shape of the ordinary gramophone horn certainly did not lend itself to reflections of that kind, and I came regretfully to the conclusion that a forward tone, such as the experts desired, could only be obtained if the air column and (?) the horn were resonating violently at as many frequencies as possible so that the whole of the horn, plus the air near the mouth, was involved in the resonating process and no doubt by building up a sufficient number of resonances, an instrument capable of making a fine loud noise would be produced!

One of the firm's slogans at the time was "It rings out loud and clear," and so we have a clue to the ideas of perfect reproduction of the early '20's.

Now, getting down to fundamentals, a starting point, and a practical example, undistorted sound is that obtained direct by the listener sitting in the actual Concert Hall itself, the ideal case.

If we analyse what he hears, however, we



THE IDEAL CASE

will note that while he hears the direct sound from the Artist, he hears also echoes coming from the ceiling, the back of the Hall, the sides of the Hall, and many multiple reflection echoes which have traversed lengthy paths. Moreover, the echoes reaching his right ear may differ in detail from the echoes reaching his left ear, while with a multiple source of sound there are in addition differences in the arrival times of the sound at his two ears. Any hope of reproducing all these with correct time differences involves two channels and is out of question from the general point of view because of the extra cost.

Fundamentally, therefore, this simple starting point cannot be a guide, and what is required is something which should be as realistic as possible but single channel.

Let us consider now the inescapable conditions of listening in the home. The echo which comes from behind in the Concert Hall may come with a delay corresponding to a sound travel time of 100 feet or more. In the case of the listener at home, however, any echo arriving from the back will be late by the time corresponding to a few feet of travel only. This applies also to the ceiling and any of the other internal reflections which belong to the room in which the listening takes place.

Let us assume now that some lucky citizen is by some magic carried, complete with his listening room, into the Concert Hall and can listen direct through his open window to what is coming in from the stage. If he is suitably placed, he can see the Artist and receive the direct sound wave without any alterations. The first echo reaching him from behind will be a short time echo of the type which belongs to his room. There will be the other usual room echoes, and in addition, there will be long time echoes belonging to the Concert Hall, but they will enter his room by the open window, that is from the same direction as the initial direct sound.

We have thus something, which though not scientifically pure single channel is at least very close to it. Moreover, this particular arrangement preserves at the listener's ears the reverberation of the room in which he is situated and which he cannot eliminate except by using headphones.

It preserves, in a general way, the reverberant effect of the Concert Hall, but deprives the listener of the effect of the spread of the orchestra, i.e., the double channel effect. This is done, however, without introducing distortion due to microphones, valves, transformers, or other non-linear contrivances.

For orchestral works and the like I regard

* *Voigt Patents Ltd., London S.E. 26, England.*

the above as being the general mental picture to visualise when judging whether sound is well reproduced. In other words, when listening can you close your eyes and imagine yourself situated in the conditions outlined in the foregoing?

Those conditions do not, however, always apply. There is the special case when the Announcer or the Artist is close up to the microphone.

The particular non-electric arrangement corresponding most nearly to that special case, I visualise as occurring when the Announcer or the solo Artist steps up close to the opening in the room above-mentioned and makes his announcement, or plays his instrument for the special benefit of the listener inside the room.

If the distance in the Concert studio between the microphone and the Artist is increased, the effect, to the listener, should be that of the Artist receding further and further from the opening and consequently his voice as heard direct should be accompanied by a bigger and bigger proportion of the reverberation which belongs to the Concert Hall. The reverberation which belongs

THE SPECIAL CASE

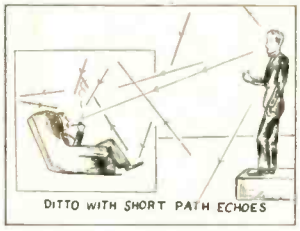
to the listening room is, however, fixed and ordinarily the listener is so accustomed to it that he is not conscious of its independent existence.

From the above I came to the conclusion a very long time ago, that when the loudspeaker and the whole of the rest of the chain is perfect, the listener who listens to such an electro acoustic chain will be hearing sound which will seem *identical with what he would expect to hear if his room had been transferred to the Concert Hall and he was listening direct through a suitable opening.*

Over the last two decades, with each technical step forward in the practice of sound reproduction, whether it was a widening of the frequency range, a reduction of amplitude distortion or an improvement in transients, the aural result has come nearer to expectations according to my theory above.

I have expounded this "hole in the wall" theory at many lectures over the past twenty years or so. It has caused much argument and even some ridicule, but I believe it to be fundamentally sound.

Should perfect single channel sound re-



DITTO WITH SHORT PATH ECHOES

production sound as though the loudspeaker had "fallen away" leaving an opening connecting directly to the studio? Or should it sound "as though the orchestra was in the room"?

FAIR EXHIBITORS

[*from page 32*]

CINEMA ENGINEERING COMPANY 516
1510 W. Verdugo Ave., Burbank, Calif.
Products: Magnetic recorders; equalizers, wave filters, precision resistive devices.

IN ATTENDANCE
Art Davis, *Chief Engineer*

CLOUGH-BRENGLE CO. 526
(Gawler-Knoop Co., 1060 N. Broad St., Newark, N. J.)
Products: Sweep-frequency generators, instruments.

IN ATTENDANCE
Charles L. Gawler — Walter A. Knoop
H. C. Gawler — Allen W. Janes

THE DAVEN COMPANY 616
191 Central Ave., Newark, N. J.
Products: Attenuators; potentiometers; laboratory test equipment such as—transmission measuring sets, electronic voltmeter, output power meter; audio effects filters, RF and Video components, resistors, switches, etc.

IN ATTENDANCE
Lewis Newman, *Pres.*
J. P. Smith, *Chief Engr.*
Richard J. Newman, *Engineer*
E. L. Grayson, *Sales Mgr.*
C. F. Scott, *Engineer*
K. K. Garrison, *Engineer*

ALLEN B. DUMONT LAB., INC. 526
(Gawler-Knoop Co., 1060 N. Broad St., Newark, N. J.)
Products: Cathode ray oscillographs, voltage and time calibrators.

IN ATTENDANCE
Charles L. Gawler — Walter A. Knoop
Harry C. Gawler — Allen W. Janes

ELECTRONICS OF STATEN ISLAND, N. Y. 537
363 Victory Blvd., Staten Island, N. Y.
Products: Loudspeaker horn enclosures; cabinetry and custom audio devices.

IN ATTENDANCE
Simon Friedland

ELECTRONIC WORKSHOP, INC. 534
351 Bleecker St., New York
Products: Audio amplifiers, oscillators, custom equipment, instruments.

IN ATTENDANCE
H. F. Sterling, *Pres.*
Alan Sobel, *Engineer*
Len Sherry, *Engineer*
Frank Ganci, *Gen. Mgr.*
Jay Carver, *Prod. Mgr.*
Jan Syrjala, *Technician*

ELECTRO-VOICE, INC. 629
Buchanan, Mich.
Products: Microphones, pickups, cartridges, loudspeakers, loudspeaker cabinets and components, TV boosters.

IN ATTENDANCE
A. R. Kahn, *Pres.*
H. T. Souther, *Mgr. Spkr. Div.*
W. F. Soules, *Sales Mgr.*
J. E. Willson, *Eastern Sales Mgr.*

FAIRCHILD RECORDING EQUIP. CORP. 653
154th St. & 7th Ave., Whitestone, N. Y.
Products: Tape recorders and equipment.

IN ATTENDANCE
Jay H. Quinn — Leon A. Wortman

FM & TV MAGAZINE 539
Great Barrington, Mass.
Products: FM & TV Magazines; audio equipment for demonstration.

IN ATTENDANCE
Milton B. Sleeper, *Publisher*
Charles Fowler, *Bus. Mgr.*
Ray Allison, *Assoc. Editor*

FISHER RADIO SALES CO., INC. 529
41 E. 47th St., New York
Products: Concertone magnetic tape recorders.

IN ATTENDANCE
Avery R. Fisher — Emanuel Berlant

GATES RADIO COMPANY 607
Quincy, Illinois
Products: Broadcast station, speech input equipment and accessories.

IN ATTENDENCE
Fred O. Grimwood, *Vice Pres.*
Norbert Yochem, *Chief Audio Engr.*
Owen J. McReynolds, *Eastern Sales Mgr.*
L. Cervone, *N. Y. and New England Sales Engr.*

GAWLOR-KNOOP COMPANY 526
(Manufacturers' Representatives)
1060 Broad St., Newark, N. J.
Representing: Allen B. DuMont Laboratories; Ballantine Laboratories; Clough Brengle Co.
Products: Audiomatic sweep generator; audio oscillator; electronic voltmeter; cathode-ray oscillographs.

IN ATTENDANCE
Harry C. Gawler, *Partner*
Walter A. Knoop, *Partner*
Charles L. Gawler, *Partner*
Allyn W. Janes

GENERAL ELECTRIC COMPANY 532
Electronics Park, Syracuse, N. Y.
Products: Speakers, standard and professional pickup cartridges, styli, tone arms, preamplifiers, and phono-tuner kit.

IN ATTENDANCE
E. A. Malling, *Sales Mgr., Component parts*
T. J. Nicholson, *Asst. to Sales Mgr.*
Mark Woodworth, *Comml. Engineer*

HARRISON RADIO CORPORATION 608
225 Greenwich St., New York
Products: Assorted audio equipment.

IN ATTENDANCE
Bil Harrison — Ted Snito

HARVEY RADIO COMPANY, INC. 631
103 W. 43rd St., New York
Products: Assorted audio equipment

IN ATTENDANCE
Harvey E. Sampson, *Pres.*
Sam Findling, *Store Mgr.*
Roy Neusch, *Sales Mgr.*
George Zarrin, *Asst. Store Mgr.*

HUDSON RADIO & TELEVISION CORP. 635

212 Fulton St., New York

Products: Audio, AM and FM equipment and components.

IN ATTENDANCE

Sol Baxt, *Pres.*
C. Carlson
L. Friedman
L. Klein, *Sales Mgr.*
A. Straus
E. Samuel

LANGEVIN MANUFACTURING CORP. 538

37 W. 65th St., New York

Products: Microphone and line amplifiers, tube and selenium power supplies, transformers, fixed-frequency receivers.

IN ATTENDANCE

D. S. Morgan, *Pres.*
Paul Zolwier, *Sales Service Supervisor*
F. K. Hankinson, *Transformer Sales Mgr.*
David Fidelman, *Project Engr.*
G. V. Rosenquist, *Gen. Mgr.*
John Harris, *Chief Engr.*
John Guenther, *Project Engr.*

JAMES B. LANSING SOUND, INC. 604–605–606

2439 Fletcher Drive., Los Angeles, Calif.

Products: Speakers of quality.

IN ATTENDANCE

Leonard Larson

LEONARD RADIO, INC. 536

69 Cortlandt St., New York

Products: Miscellaneous audio items; speakers, amplifiers, microphones, and tuners.

IN ATTENDANCE

Sidney Schugar, *Mgr.*
Joseph Chislo, *Engr.*
Arthur Priest, *Adv. Mgr.*
Ellis Rosen, *Salesman*

MAGNECORD, INC. 604–605–606

360 N. Michigan Ave., Chicago, Ill.

Products: Magnetic recording and reproducing equipment, amplifiers, and speakers.

IN ATTENDANCE

C. G. Barker, *Vice Pres.*

McINTOSH ENGINEERING LABORATORY 604–605–606

Silver Spring, Maryland

Products: Amplifiers.

IN ATTENDANCE

Frank McIntosh

MEASURMENTS CORPORATION 527

Boonton, N. J.

Products: Test equipment.

IN ATTENDANCE

H. W. Houck, *Pres.*
Jerry B. Minter, *Chief Engr.*
Edgar M. Weed, *Adv. Mgr.*
Wm. Albert, *Dir. of Purchases*
John M. Van Beuren, *Chief Res. Engr.*
N. C. Dolnnd, *Sales Mgr.*
John H. Redington, *Sales Engr.*

MIDWAY RADIO AND TELEVISION CORP. 609

60 W. 45th St., New York

Products: High-Fidelity sound equipment.

IN ATTENDANCE

Paul Berke, *Pres.*
Harold Kahn, *Sec'y.*
Sol Sternnn, *Treasurer*
Harry Diamond, *Vice Pres.*
Hy Rosenberg, *Adv. Mgr.*

MILO RADIO & ELECTRONICS CORP. 641

200 Greenwich St., New York

Products: Amplifiers, pickups, speakers, microphones, tape recorders, and assorted audio equipment.

IN ATTENDANCE

Milton Putterman, *Pres.*
Leo Klein, *Gen. Mgr.*
Basil Guerra, *Salesman*
Al Patane, *Mgr. Sound Dept.*
Mal Tepper, *Store Mgr.*
Mattie Williams, *Pur. Mgr.*

PANORAMIC RADIO PRODUCTS, INC. 626

10 S. Second Ave., Mt. Vernon, New York

Products: Model AP-1 Panoramic Sonic Analyzer. Model SB-7 Panoramic Ultrasonic Analyzer. Panoramic Sonic Response Indicator.

IN ATTENDANCE

Bernard Schlessel, *Sales Mgr.*
Robert Shologan, *Engr.*
Robert Augustine, *Engr.*

PEERLESS ELECTRICAL PRODUCTS DIV. 618–619

(Altec Lansing Corp.)
161 Sixth Ave., New York

Products: Power transformers; filter chokes; input, interstage, output, modulation, and replacement transformers. "A transformer for every audio application."

IN ATTENDANCE

H. S. Morris
Mel Sprinkle
Dave Sonkin
Marty Wolf

THE PERMOFLUX CORPORATION 640

4900 W. Grand Ave., Chicago, Ill.

Products: Loudspeakers and headsets.

R. S. Fenton, *Sales Mgr.*
L. M. Heineman
Mike Del Camp, *Asst. to Sales Mgr.*
Rex L. Munger, *Jobber Sales Mgr.*

PICKERING & COMPANY, INC. 624–625
Oceanside, N. Y.
Products: Pickup cartridges, arms, equalizers, and associated pre-amplifiers and amplifying components; loudspeakers; intermodulation distortion measuring devices.

IN ATTENDANCE
Norman C. Pickering, *Pres.*
George Petelin, *Sales Dept.*
Walter O. Stanton, *Vice Pres.*

PRESTO RECORDING CORPORATION 612
P.O. Box 500, Hackensack, N. J.
Products: Disc and tape recording equipment; disc and tape transcription equipment; amplifiers; blank recording discs.

IN ATTENDANCE
George J. Saliba, *Pres.*
Thomas B. Aldrich, *Sales Mgr.*
Irv. Rosenblatt, *Engr.*
M. M. Gruber, *Sec'y.*
John Strampfer, *Prod. Mgr.*
Fred Jarysz, *Engr.*

RADIO CORPORATION OF AMERICA 632–633–634
RCA-VICTOR DIVISION
Camden, N. J.
Harrison, N. J.
Products: Magnetic tape and film recording equipment, microphones, amplifiers, loudspeakers, component parts.

IN ATTENDANCE

J. P. Taylor	A. K. Ward
C. M. Lewis	R. A. Tenre
M. A. Trainer	W. L. Tesch
A. C. Lindquist	T. A. DeSimone
W. O. Hadlock	W. L. Lawrence
L. T. LaPatka	L. LeKashman

RADIO MUSIC CORPORATION 535
84 S. Water St., Port Chester, N. Y.
Products: Audio equipment design, development, and manufacturing.

IN ATTENDANCE
Lionel Cornwell — Donald Heyil
J. F. Rigby

RADIO & TELEVISION NEWS 533
366 Madison Ave., New York
185 N. Wabash Ave., Chicago, Ill.
Products: Magazines.

IN ATTENDANCE
Oliver Read — Murray Goldman
Leonard R. Osten — Jerome Jacobs
Harrie K. Richardson

RANGERTONE, INC. 621
73 Winthrop St., Newark, N. J.
Products: Multichannel tape recorders, professional tape recorders, synchronized tape recorders.

IN ATTENDANCE
Sam L. Ackerman — R. H. Ranger
F. Whitehouse — P. Brubaker
A. V. Colabella — Robert Walker

SATURDAY REVIEW OF LITERATURE 539
25 West 45th St., N. Y.
Products: "America's No. 1 Recording Section"

IN ATTENDENCE
Jay Woodruff, *Advt. Mgr. Rec. Sec.*
Irving Kolodin, *Editor*
Roland Gellatt, *Assoc. Editor*
Edward T. Canby, *New Recordings*
Bert Garmise, *Dial of Recordings*

HERMON HOSMER SCOTT, INC. 528
385 Putnam Ave., Cambridge, Mass.
Products: Dynaural noise suppressors, high-fidelity audio amplifiers, sound and vibration measuring equipment, electronic and acoustical laboratory apparatus.

IN ATTENDANCE
H. H. Scott, *Pres.*
E. G. Dyett, Jr., *Prod. Mgr.*
V. H. Pomfer, *Sales Mgr.*

MARK SIMPSON MFG. CO., INC. 603
32-28 49th St., Long Island City, N. Y.
Products: Magnetic tape recorders, transcription players, high-fidelity amplifiers, and sound systems.

IN ATTENDANCE
Mark Simpson, *Pres.*
G. L. Werner, *Chief Engr.*
Henry Berlin, *Sales Engr.*
R. Asen
Miryam Simpson, *Vice Pres.*
David Libsohn, *Asst. Sales Mgr.*
S. Nachilgall, *Exec. Engr.*
Bill Wolfner

REEVES SOUNDCRAFT CORP. 602
35-54 36th St., Long Island City, N. Y.
Products: Blank recording discs, magnetic recording tape, recording accessories.

IN ATTENDANCE
A. C. Travis, *Vice Pres.*
John Travis, *Sales Engr.*
Don. E. Ward, *Sales Mgr.*
David Ruark, *Adv. Mgr.*

REK-O-KUT COMPANY, INC. 636–637
38-01 Queens Blvd., Long Island City, N. Y.
Products: Rek-O-Kut recording and equipment, motors, turntables, and equipment.

IN ATTENDANCE
George Silber, *Pres.*
H. Siegal, *Asst. Sales Mgr.*
Sidney Simonson, *Vice Pres.*
Frank Scanell, *Sound Engr.*

SOMERSET LABORATORIES, INC. 627
1701 Palisades Ave., Union City, N. J.
Products: Amplifiers and noise suppressors.

IN ATTENDANCE
Carl E. Ring, *Pres.*
Frank Guenther, *Engr.*
Edw. Van Rosser, *Assistant*
Sidney Colerrian, *Chief Engr.*
Helen Connelly, *Sec'y.*

SONAR RADIO CORPORATION 652
59 Myrtle Ave., Brooklyn, N. Y.
Products: Tape recorders and allied audio equipment.

IN ATTENDANCE
Edw. A. Babkes, *Pres.*
Syd. D. Yarm, *Mech. Engr.*
Jack Babkes, *Chief Engr.*
Anthony Spam, *Asst. Engr.*

STEPHENS MANUFACTURING CORP. 620
8538 Warner Dr., Culver City, Calif.
Product: Loudspeakers and microphones.

IN ATTENDANCE
Robert L. Stephens, *Pres.*
Sam S. Egert, *Representative*
Michael Scott, *Representative*
Norman Simons, *Export Mgr.*
Jack Fields, *Representative*

SUN RADIO & ELECTRONICS CO., INC. 601
124 Duane St., New York
Products: Assorted audio equipment, speakers, amplifiers, tone arms, pickups, kits, etc.

IN ATTENDANCE

Sam Gerard — Irving Greene
Sandy Herman

TECH LABORATORIES, INC. 647
Bergan & Edsall Blvds., Palisades Park, N. J.
Products: Attenuators, potentiometers, reverberation generator, monitoring amplifiers, etc.

IN ATTENDANCE

M. Bjorndahl, *Pres.*
G. Van Baaren, *Sales Mgr.*
G. Harris
K. Meri
E. Bjorndahl, *Vice Pres.*
A. L. Budd
W. Richards

TERMINAL RADIO CORPORATION 622
85 Cortlandt St., New York
Products: Audio equipment and components.

IN ATTENDANCE

Robert Corey — Wm. Filler
Jack Simon

THE TETRAD CORPORATION 623
60 N. Broadway, Yonkers, N. Y.
Products: Diamond phonograph styli.

IN ATTENDANCE

Morton V. Marcus, *Pres.*
Emanuel J. Marcus, *Sec'y.*
Howard M. Weinberger, *Vice Pres.*

TRIAD TRANSFORMER MFG. CO. 530
2254 Sepulveda Blvd., Los Angeles, Calif.
Products: Transformers, reactors, hermetic terminals.

IN ATTENDANCE

L. W. Howard, *Partner & Chief Engr.*
Ernest Clover, *Geophysical Engr.*

UNITED TRANSFORMER CO. 639
150 Varick St., New York
Products: Transformers, filters, and amplifier kits.

IN ATTENDANCE

S. L. Baraf, *Vice Pres.*
Bob. Mitchell, *Engr.*
S. Rubin, *Engr.*
Ben Miller, *Sales Mgr.*
Joe Barecca, *Engr.*
S. Manville, *Engr.*

UNIVERSITY LOUDSPEAKERS, INC. 611
80 S. Kensico Ave., White Plains, N. J.
Products: Loudspeakers.

IN ATTENDANCE

Irving Golin, *Pres.*
Lawrence J. Epstein, *Sales Mgr.*

UNIVERSITY LOUDSPEAKERS, INC. 611
80 S. Kensico Ave., White Plains, N. J.
Products: Commercial, industrial, and high-fidelity loudspeakers and accessories.

IN ATTENDANCE

S. J. White, *Chief Engr.*
A. Cohen, *Project Engr.*
Arthur Blumenfeld, *Prod. Supt.*
Sidney Levy, *Dir. of Eng.*
Vincent Carey, *Sales*
Seymour Blumenfeld, *Sales*
Edward Reese, *Engr.*

AES CONVENTION PROGRAM

[*from page 30*]

COMMUNICATION FACILITIES

R. B. MONROE, *Columbia Broadcasting System*

Television studio intercommunication facilities are just as important in successful television program production as the associated audio and video facilities. The intercommunication installation should therefore receive the same careful planning and attention to design detail as is accorded to the sound and picture portion of the plant. This paper discusses the philosophy underlying the design of television studio intercommunication systems and describes the facilities in use at CBS.

11: 15 a.m.

A NEW POWER-AMPLIFIER CIRCUIT INCORPORATING "EXTENDED CLASS-A OPERATION"

HOWARD T. STERLING, *The Electronic Workshop, Inc.*

A new power-amplifier circuit is described which features Class-A operation at power levels and efficiencies normally associated with Class-AB and Class-B operation. The new method of operation, which has tentatively been called "extended Class A," avoids the distortion resulting from the switching transients encountered when tubes are driven to cutoff. No special transformers are required. The new circuit provides damping factors of the order of those obtainable with conventional triode amplifiers without the use of feedback.

12: 00 noon to 2: 00 p.m. Lunch Recess

2: 00 p.m. . . . . Technical Session

Grand Ballroom

THEODORE LINDENBERG, *Chairman*

DIRECT RADIATOR LOUDSPEAKER MOUNTINGS

H. F. OLSON, *RCA Laboratories*

Variations in the response-frequency characteristic of a direct-radiator loudspeaker are produced by resonance and diffraction effects introduced by the mounting arrangement. Variations in the response are also produced by the diffraction effects introduced by the outside configuration of the cabinet. Grills, screens, and cloths used as coverings for loudspeakers introduce variations in the response-frequency characteristic due to the lumped acoustical impedance presented by these systems. Experimental data will be given to show the effect of these elements upon the response of direct-radiator loudspeakers. Demonstrations will be arranged to show the effect of the mounting arrangement, cabinet, and grill upon the response-frequency characteristic of a loudspeaker.

2: 35 p.m.

THE MEASUREMENT OF AUDIO VOLUME

HOWARD A. CHINN, *Columbia Broadcasting System*

This tutorial paper reviews the basic philosophy which led to the concept of audio "volume" and discusses the relative merits of peak versus r.m.s. measurements. The American Standard volume indicator is described, together with the principles that should be observed in the application of the instrument. Volume measurement terminology (e.g., vu vs. dbm) is explained, and accepted program transmission level practices detailed.

3: 10 p.m.

A NEW LOW-COST INTERMODULATION MEASUREMENT AND ANALYSIS TECHNIQUE

C. J. LEBEL, *Audio Instrument Co.*

The old method of using an oscilloscope to judge intermodulation in audio systems has been

developed into an inexpensive but quantitative method by this study.

The widely held opinion that there is a firm relationship between harmonic and intermodulation distortions is shown to be entirely wrong. The only way to determine the intermodulation distortion of a unit is to measure it directly.

The use of oscilloscope patterns for adjusting amplifiers and other components in factory test and laboratory will also be discussed, with a number of illustrations.

3:45 p.m.

LOUDSPEAKER DAMPING

ALBERT PREISMAN, *Capital Radio Engineering Institute*

Adequate damping of the motion of a loudspeaker cone is shown to be one of the principal considerations in the design and application of these units. The effects of horns and of various types of baffles are shown, and it is proved that proper damping of a speaker by means of the correct design of its electrical characteristics will provide more satisfactory operation with an increase in efficiency, whereas mechanical damping decreases efficiency. Practical methods of measuring mechanical impedance of a loud-speaker are described, together with means for adjusting the electrical characteristics under which the loudspeaker operates.

4:20 p.m.

REPORT OF AES STANDARDS COMMITTEE ON PLAYBACK CHARACTERISTICS

S. EDWARD SORENSEN, *Columbia Recording Corp.*

SATURDAY, OCTOBER 28, 1950

9:30 a.m. to 12:00 Noon
Magnetic Recording Session

Grand Ballroom

PRICE FISH, *Chairman*

MULTI-CHANNEL MAGNETIC RECORDING

PAUL M. BRUBAKER, *Rangertone, Inc.*

Discussion on the problem of adjacent channel interference on low frequencies and use of amplitude modulation as a solution to the problem. This allows for a four-channel high-fidelity recorder using ½" tape playing four hours at 7½"/sec. and usable down to 45 cps or lower depending upon application. Utilizing amplitude modulation techniques, a 12-channel telemetering system is possible using ¼" tape. All of the possible sources of error are minimized by negative feedback or a.v.c. allowing for an over-all system accuracy of plus or minus 3 per cent.

10:05 a.m.

A SOLUTION TO THE MAGNETIC TAPE TIMING PROBLEM

D. R. ANDREWS, *Radio Corporation of America*

The dimensional instability of base materials used in the manufacture of magnetic recording tape makes it imperative that some means of control be employed if careful timing of recorded programs is to be maintained. Various systems which may overcome this handicap are briefly described.

One specific system is described in detail. It provides very accurate timing over long time-periods. A signal is generated from optical markings on the reverse of the tape. This signal is scanned and compared with a standard frequency for speed correction. Means is provided for using either marked or standard tape interchangeably.

10:40 a.m.

A NEW EXPLANATION OF THE ACTION OF A.C. BIAS IN MAGNETIC RECORDING

W. W. WETZEL, B. J. MURPHEY, and R. HERR, *Minnesota Mining & Manufacturing Co.*

Although the beneficial effects of a.c. bias on

magnetic recording have been recognized for over twenty years, no satisfactory explanation of its action has appeared in the literature. A series of simulated recording experiments was designed to determine the effect of recording gap fields on the final state of magnetization of a recorded tape. It was shown that an-hysteric magnetization alone was not sufficient to explain the bias action. However, if account is taken of the phase of the bias as a particle reaches the center of the gap and if the average value of the magnetization over one wavelength of the bias field is considered, the experiments are in qualitative agreement with observations made on recording machines. These experiments will be described and the new theory of the action of a.c. bias explained.

11:15 a.m.

SPROCKET HOLE TAPE IN MAGNETIC RECORDING

ARTHUR C. DAVIS, *Cinema Engineering Co.*

A discussion of the mechanical, electrical, and electronic problems involved in synchronous drives employed in recording systems. Synchronization being necessary, it is shown to be far simpler to employ sprocket driven recording tape which interlocks directly with the cameras driving the film in TV recording cameras. The various types of sprocket drives are analyzed.

NICKEL ALLOY STEELS

[*from page 21*]

L. E. Barton, "High Audio Output from Relatively Small Tubes,"* July 1931.
B. J. Thompson, "Graphical Determination of Performance of Push-Pull Audio Amplifiers," April 1933.
J. R. Nelson, "Class B Amplifiers Considered from the Conventional Class A Standpoint," June 1933.
J. A. Hutcheson, "Application of Transformer-Coupled Modulators," July 1933.
Paul W. Klipsch, "Design of Audio Frequency Amplifier Circuits Using Transformers," Feb. 1936.
True McLean, "An Analysis of Distortion in Class B Audio Amplifiers,"* March 1936.
Loy E. Barton, "Recent Developments of the Class B Audio and Radio Frequency Amplifiers," July 1936.
E. M. Wise, "Nickel in the Radio Industry," June 1937.
Geo. H. Fritzinger, "Frequency Discrimination by Inverse Feedback," Feb. 1938.
H. F. Mayer, "Control of the Effective Internal Impedance of Amplifiers by Means of Feedback," March 1939.
Karl Spangenberg and Winslow Palmer, "A Phase-Shifting Device for the Rapid Determination of Audio-Frequency Amplifier Characteristics," Sept. 1939.
F. E. Tenney, R. R. Buss, W. R. Hewlett, F. C. Cahill, "Some Applications of Negative Feedback with Particular Reference to Laboratory Equipment,"* Oct. 1939.
Horatio W. Lamson, "A Method of Measuring the Magnetic Properties of Small Samples of Transformer Laminations," Dec. 1940.
John K. Hilliard, "Distortion Tests by the Intermodulation Method," Dec. 1941.
Wayne B. Nottingham, "Optimum Conditions for Maximum Power in Class A Amplifiers," Dec. 1941.
Stewart Becker, "The Stability Factor of Negative Feedback in Amplifiers," June 1944.

* Particularly useful in design of audio transformers.

POPS

[from page 38]

tion of 30,000, only 1,000 men could work at anything remotely steady and secure. The rest were ultimately doomed. Living on the typical musician's hope that tomorrow will bring a telephone call from a contractor for a recording session or a new show or a substitute's job, they persisted in the whimsical traditions of the silver lining, tomorrow is a better, and if at first you don't. With increasing yearly unemployment, the situation continued to go from bad to worse until the denouement, which began approximately six weeks ago.

One of the best jobs in music has been radio work. With a moderate amount of security (because there is no such thing as true security in this business), the life of the radio musician was something better than average. But now, radio too has given up the ghost. One broadcasting system is reported to have given notice to almost all the "legitimate" musicians on their staff, a process which is being paralleled by the other networks and will shortly see the total absence of "live" classical music on the air. The doubler (the guy who plays more than one instrument and therefore can be used to cut down on the number of men needed for a specific arrangement) is in his glory and is being almost exclusively used in the "live" dance dates on radio and other media of musical expression. There is a possibility that one of the oldest live classical music standbys on the air may not resume next season (at least live), and the days of another Symphony are apparently numbered.

We have finally entered the peak stage of the canned music era. There will be plenty of opportunity to hear classical music via records. Small local FM stations as well as the networks will continue to play classical music . . . via records. There is even a good possibility that live "pop" will soon see itself displaced by the ten inch spinner. What does it all add up to? One sentence could sum up the whole situation, and if you think this is melodramatic, stay in bed for a few months and then pop your head out into the big wide world and see what's happening. . . .

Potential Death of Serious Music

That's right . . . bold type and a simple stark sentence. If you don't believe me, write, phone, telegraph or visit in person any number of musicians in New York, Chicago, and L.A. and ask them. At long last, the overpopulation problem may be solved. A lot of musicians are already talking seriously about leaving the business. This winter, if things continue as they probably will, a lot more will be engaged in occupations which don't require the ability to read music. What kind of musicians will leave? The best! Further up in the column, I indicated that in a city with a population of 30,000, only 1,000 men were adequately employed. I said nothing about the quality of either the employed or unemployed. Some of the finest musicians in this country belong in the 29,000 unemployed category. What happens when they leave? What happens when kids stop killing themselves in the process of a musical education because they finally realize that the glamorous dream is compounded of tinsel and that they'll probably starve to death if they go into the music business? What will happen to the manufacturers of instruments and accessories when the mar-

ket is reduced to zero? And, the most important question, what is going to happen to the quality of musicians and orchestras?

It is now time for you to shrug your shoulders and emit coy little exclamations like, "Nonsense," "Pshaw," "Impossible," "Fantastic," "Unbelievable," "Whosehetryintascare" and "Whaddyaknow," but it's true . . . yep . . . all true, and if you want the proof, a little investigation and statistical study will bear me out.

This column cannot go into the economic details of the situation or probe around the ideas for subsidization, etc. However, this column can and will take a nasty swipe at the one aspect of the situation which is directly within our frame of reference . . . wreckords. All we wreckord geniuses have been spouting the gospel about the superiority of the canned goods for years now. Were we right? Nah! Did people take us seriously? At long last, yes! Should they have? Nope!

No matter how you stretch it, no matter how many text books, articles, theses are written year after year, no record and no record reproduction machine has or will be able to supplant live music. The audio engineer and the subsidiary groups working with him have been concerned with very real and very practical problems involving motion picture sound tracks, auditorium amplification, tape reproduction, etc. Their ends were very simple . . . to achieve a level of sound reproduction which either came as close to the original performance as possible or handled the material to be reproduced accurately in terms of the ends involved. Because of improvements in equipment and the gradual sophistication of theory, it was possible to reach a stage of accomplishment pretty close to the theoretical optimum. Are we therefore justified in replacing live performances with records?

As far as I am concerned, the answer is *no*. There are some audio prophets who maintain that it is still possible, despite present skepticism, to achieve perfect reproduction on records. Despite the thousands of problems, including the acoustical limitations of the average living room, the limits of the average purse . . . assume that perfect reproduction is indeed possible. Are we still justified in limiting musical experiences to records? The answer is again no, and for what may be considered an extraneous reason. It is now possible to achieve performances on records which are technically, in the musical sense, perfect. No clinkers, no mistakes need appear in a recorded performance. Tape editing has been reduced to the utmost simplicity, and passages which in the original take were inadequate can be repeated and edited in. Is the earmark, hallmark, and questionmark of a good performance the absence of clinkers? Nope! A good performance is a totality which is and must be seen in terms of untechnical factors, including phrasing, tempi, balance, etc. There has never been and never will be any one performance which is so perfect that a listener with a good ear and with a moderate amount of musical sophistication would want to hear it over and over again, unchanging, and always played and heard under the same conditions.

There is a special kind of excitement involved in a live performance. The specific performance can never be repeated, and despite the number of rehearsals and the quality of the orchestra and the conductor, cannot be perfectly anticipated. Certain ineffable psychological factors enter in which cannot be overlooked . . . the spontaneity of even the best rehearsal program, the particular attitude and calibre of the audience, and so on. The audience-musician relationship is one of the most vital factors that goes into the making of the great moments in music. Without it, music is reduced to the level of a photostat, reproducing what is on the printed score, but lacking the particular and quintessential reality of the original. Quality musicians result from the eternal battle (a face-to-face battle) which results in the concert hall between musician and audience. Quality musical performance results from the generation of a particular emotional response out of the details of the moment. The artist, the performer, whatever you want to call him, must work for somebody, must act, perform and do for an immediate somebody. Without the somebody, he is dependent upon a strength of character and an absence of egoism which cannot be expected even of the strongest of men. The electricity of the great concert is not recordable.

Records were created and are made to serve a dual purpose; they augment and temporarily replace the concert hall. They are a temporary convenience, and nothing more. Where live music is inaccessible, they are a necessity. Where it is accessible, they help solve the problems involved in a limited concert season and a limited repertoire. They are meaningful only if they augment the real thing. The psychological advantages of seeing as well as hearing are obvious and need not be mentioned. The communion between musicians and audience is also obvious. Without the communion, without the audience-musician battle, with-

out the precariousness of the performance which cannot be repeated, but can only be played once (you cannot go back and repair mistakes during a concert), music and musicians are reduced to the level of mechanical auxiliaries to a cutting stylus. Quality degenerates (and Mr. Canby can certainly testify to this in the modern history of recordings) to a mediocre mean. A recorded performance need satisfy only the average and is impervious to the screams of the demanding.

But this is really only an academic discussion. The perfect record is hypothetical, the perfect reproduction apparatus is still theoretically out of the question. The transparency and liquidity of pianissimo passages, the tension and accuracy of *tuttis*, played fortissimo, the whole area of sound subtlety is absent. We are easily fooled by the illusion and allusion of their presence in some of the better recordings of recent years, but they just aren't there. To a group, brought up on the musical horrors of AM radio presentation, modern recording sounds tremendous. Get them back into the concert halls for a while (assuming they don't all have tin ears) and the myth is easily dispelled.

If you agree with the above, I assure you that the crisis as described earlier exists. At the moment, there is no ready solution. One thing is certain, if you will be content with a few hours of hoof beats on the range, videoed seven days a week, and if you are content with the present state of affairs, nothing will happen. Since competition among musicians will cease, recordings will become more and more mediocre. Fewer and fewer men will come into the business (the job opportunities presented by the recording industry are extremely limited), and musical standards will reach an unbelievable low. Of course, it may eventually be possible to dispense with musicians entirely. If you like that idea, we might as well all give up and learn to appreciate the human sounds of a sneeze.

All and every kind of music is involved. The people who still count are the guys and gals who have loose change in their pockets and can determine the direction any industry moves. If you don't buy records, if you don't listen to canned radio broadcasts, if you refuse to go to concerts because of inadequate musicians and inadequate conductors, changes will have to be made. If you want to hear good jazz, good pops, good serious music, you have to make it possible for the people responsible—the musicians—to stay alive and achieve some form of artistic and economic security. If you have any pride in the records you have or in the equipment that plays them back for you, you will demand that what goes onto the discs is first rate. I have outlined the conditions which are and will continue to jeopardize such a possibility. Who gives a hang for perfect equipment which reproduces trash? I don't! I'm angry and frightened about the prospects . . . it's about time that you were.

NEW RELEASES:

Charlie Parker With Strings
Mercury MG 35010

I was introduced to this new LP release by one of the noble Pop "critics" so casually dismissed before. I was told in ecstatic terms that this was one of the greatest things that had ever happened . . . that I would revel in its mellifluous and tonic vibrations . . . and that there was none better. So sorry . . . but . . . it's all nonsense. I will quote

from Norman Granz's blurb on the back (Granz supervised the session) and then fill in my own comments:

"All of the music in this album shows a new Parker to most listeners. He plays the melody very closely and it's good that he does, for the tunes are truly beautiful. He plays with strings and some of the harsh effects achieved heretofore by Parker et ensemble are nowhere noticeable here, the strings softening and prettying Parker; and Parker, for the first time, plays with truly great musicians which meant he had to be, as it were, on his best musical behavior.

"Incidentally, there's been much talk about the so-called 'new sounds' in jazz: I hope you like the '. . . sounds' in this album."

A few words about Charlie Parker to begin with. Parker was the recording protegé of Ross Russell, a sincere guy who made a natural musical transition, as demonstrated by his Dial Records, to modern classical in the form of Alban Berg, Schoenberg, et al. Parker was pushed as a genius and was one of the loftiest during the bop craze. I have never agreed with the general estimate of Parker. To put it bluntly, I don't like. But this recording isn't his fault. The same thing that happened on the Shaw date, reviewed previously, has happened here. Only now, the arranger is pretty much at fault.

To begin at the beginning, balance is ridiculous. I wasn't at the date, but either Parker has the mike attached to his sax mouthpiece, or they shoved the orchestra into another room. All that comes through is an unearthly sax blast, with a chaotic mish-mash of accompaniment floating in the background at so low a level, as compared to the sax, as to cause suspicion that another recording, being made in the next studio, drifted in. The arrangements are violently bad. There is no clear stylization. Oboe comes threading in against bad percussion breaks . . . string writing is muddled. Harp use is ridiculous in the context of the arrangement at points . . . and Parker . . . poor Parker . . . is way out of his depth. The whole thing is nonsense from beginning to end . . . and this is what I mean by bad supervision. On every level . . . technical, musical, (and business) a rousing raspberry. When will they ever learn that mikes cannot be used like salt! Even the pressing isn't so hot . . . Sorry Mr. Granz, I don't like the ". . . sounds" in this album. For those who are interested (and to Parker lovers, the titles should indicate something) the bands are as follows: April in Paris, Summertime, If I Should Lose You, I Didn't Know What Time It Was, Everything Happens to Me, Just Friends.

Marlene Dietrich Souvenir Album

Decca DL 5100

This is, of course, nothing new, except that it's out on a ten-inch LP. We are great admirers of La Dietrich, and two of the babies included are magnificients . . . I've Been in Love Before, and Symphonie. On originals, they should be purchased by all and sundry . . . they are marvels in stylization . . . and who worries about quality when Dietrich is on a disc. But . . . another point. Here is a case where I can throw whole-hearted support behind Victor and the '45. Except for the cases mentioned in past columns (jazz, and things requiring more than the normal three minute playing time), the LP, whether 10 or 12 inch, imposes a tyranny on the consumer as far as pops are concerned. Along with the one item in a dub, it is necessary to buy all the rest of the junk. Decca has also come out with a 10-inch LP called "The Man with the Horn" (DL 5191, if you're interested) which features Armstrong, Berigan, Spanier, Eldridge, Hackett, Brooks, Butterfield, McGhee. I, for one, wouldn't want some of the stuff on this baby. But what to do. I'm stuck with it anyhow. Outside of space (and there are too few people who own enough records to have to worry about space), there is no advnatage to these dubs. There is, as indicated above, a decided disadvantage. Either the Victor 45 or the Columbia 7-inch takes care of the problem. I don't want anybody to impose his selection on me . . . and you probably don't exactly crave it, either. Furthermore, I want to load discs on a changer in my own order . . . not an order imposed by band separation. On top of it all, the Dietrich dub is a particularly bad one. Noisy and muffled, you will do better to get the old shellacs. They are still available(including a large quantity on H.M.V. and Polydor, which are luscious).

RECORD REVUE

[from page 38]

neering thrown in. People don't come that way, though. Nor can the editor appoint a Committee of Ph.D.'s to consult and produce articles, monthly, on Audio Relations. Very few trained audio engineers could do it; engineering is not a profession that allows time on the side for training in the art of writing deathless prose, not to mention the complex sciences of music, psychology and the rest. Moreover, most engineers in any field are understandably too near the trees to see very much of their forest.

Birdseye View

Hence what you have before you, represented in print hereby. A musician officially, who happens to be a frustrated engineer at heart as well; an outsider, who knowing only a few of the major trees by their first names, manages every now and then to get a good birdseye (what am I writing?) view of a sizeable hunk of forest, in the audio area. No amateur engineer can expect to keep up with genuine Joneses in the professional engineering world, and there are plenty of things that this column will never be seen talking about in print. Leave 'em to the rest of the magazine.

But, on the other hand, as I muttered a couple of times three years ago, it's often useful to have fools rush in where engineers would rather not tread. Boners, technical ones especially, are not guaranteed absent here, in spite of the watchful eye of the editor. But if this column, boners and all, Record Revue or not, can stimulate interest, thought, even action in the audio field which redounds to audio's good (and if it makes reasonably entertaining reading . . .), then the job is done. And remember, if I make a boner, it's only me, a musician; whereas if you trained professionals do it, woe unto you! Gives me a peculiar kind of freedom, but also a peculiar responsibility: Let the little boners pass, but *don't* make big ones.

So, new subscribers, on to the Record Revue (below) and no more of this for another three years.

Tchaikowsky, Symphony #6
("Pathétique")
a) Vienna Philharmonic, Von Karajan
Columbia LP: ML 4299
b) Paris Conservatory Orch. Munch.
ALSO, same album:
Tchaikowsky, "Romeo and Juliet."
a) London Philharmonic, Van Beinum.
London LP: LLP 167 (2)
b) New York Philharmonic, Stokowski.
Columbia LP: ML 4273

One gets into complex fractions trying to make comparisons these days—here are two pieces, three recordings, in a sort of siamese-twin relationship.

These records, technically speaking, throw some interesting light on rival recording techniques. The Columbia "Pathétique" is one of the first all-British LP's, done by English Columbia, only the final pressing managed in the U. S. by our Columbia. (Another, the Haydn Symphony #100, appears below.) It competes directly, then, with the famous firr London LP recording. Results: a quite different sound, though each is clean, low in distortion. Strangely enough, in direct comparison, it

is the British Columbia which has the distant-mike, over-all sound, the London which seems as though done with a closer pickup, individual instruments standing out sharply, the strings with that typical wiry, metallic quality. Even more: the "Romeo and Juliet" recording—though here London competes with American Columbia—brings out a similar difference; the New York recording is the more distant, over-all, the London is drier, closer, sharper.

Whatever the techniques of mike placement used (and this is your guess as well as mine), the two sounds here represent examples of an old argument. Without much doubt, most engineers will prefer the closer, sharper London sound, and possibly so will musicians at first—it's super-realistic, over-natural. But in the end, for pure musical pleasure, the more distant technique is best for music like this. Why? Because it was written to be heard that way, in the binaurally equivalent situation.

Not much space for the music—I find that Von Karajan's "Pathétique" is the more exact and more musical performance; Munch's is nearer to the usual noisy weeping-of-salt-tears we get so frequently. On the other hand, Stokowski's wisely experienced way of handling the powerful stuff in "Romeo" brings his up ahead of Van Beinum's. Stokowski can be a craftsman when he's in the mood.

Haydn, Symphony #100 ("Military").
Liverpool Philharmonic, Rignold.
Haydn, Symphony #94.
Liverpool Philharmonic, Sargent.
Columbia LP: ML 4276

Same orchestra, same composer—but one of these LP's, #100, was processed entirely in England except for the final pressings here; the other, #94, was re-recorded and made into an LP here as other British records have in the past. So, at least, is my information. (See matrix numbers.) Neither of these, alas, is anything exceptional as to sound, so the comparison is not as good as it might be. The British-made LP master seems to have more bass than the U. S., whereas both have relatively flat high ends, as do most Columbia LP's originating in Britain. Very noticeably different in this respect from any domestic-recorded orchestral LP out of Columbia. The U. S. LP, my copy at least, is a poor cut, with unpleasant distortion; quite possibly this is absent in other copies. Musically, both of these are good, standard performances of Haydn, not tops but easily listenable.

Tchaikowsky, Violin Concerto.
a) New Symphony Orchestra, Sargent; Ruggiero Ricci. **London LP: LLP 172**
b) Philadelphia Orchestra, Hilsberg; Isaac Stern. **Columbia LP: ML 4232**

Back to Tchaikowsky—here are two performances of the violin concerto by not-so-big-name artists, both of whom tend to take this florid music in fairly conservative, well-mannered style. As far as I'm concerned, that's just what the music needs; but you'll find that Isaac Stern is not only well mannered, but his performance has a greater sense of depth and dignity than does Ricci. The Philadelphia orchestra does an unusually acute job under sub-conductor Hilsberg. (These Assistant and substitute conductors with unimportant sounding names sometimes turn out top rate music.) Moreover, the Columbia, for once, is really a better recording acoustically than the London, with a natural, distant violin, well blended with its orchestra. Ricci is close and dull sounding with a false relation between violin liveness and orchestra liveness.

Wagner, The Flying Dutchman.
Complete opera.
Soloists, Chorus, Orchestra of the Bavarian State Opera; Klemens Krauss. **Mercury LP: MGL 2 (4)**

This is an epoch making recording if only because it's the first complete or reasonably complete Wagnerian opera to appear on LP records. Taken from a broadcast (so I hear), the recording is nevertheless excellently done from the point of view of acoustics and balance between orchestra, solo voices and chorus. The music is, thanks be, very much alive (so many utterly mediocre LP's are coming from Europe these days), and the voices are splendid except for the soprano, who isn't overly important. If you want to feel the enormous advantage of LP for yourself—just try a side or two of this. Wagner, after all, depends on long-term build-up of musical and dramatic tension; the old 78-r.p.m. record, in spite of heroic recording efforts, never could approach it. Technically these aren't wonderful—the big voices are overcut in loud parts, highs are lack-lustre. But acoustics, performance, make up for it. It's a grand opry, too!

Smetana, "From My Life" (Quartet in E minor) arr. orchestra by George Szell.

Cleveland Orchestra, Szell.
Columbia LP: ML 2095 (10")

The transcribing of music, from one instrumental medium to another, is one of the most dangerous—and fascinating—of musical licenses; it involves, to be successful, a taste and skill in the transcriber equal to that of the composer. We've had dreadful transcriptions—here's a fine one. This is perhaps Smetana's greatest work (not counting operas); it's rarely heard by most of us. String quartet music usually makes bad orchestral stuff, and some of this isn't more than overstuffed quartet playing—but most of it is vital and exciting. The second movement, one of the most moving of pure Romantic pieces I've heard, is something you shouldn't miss. Clear, distortionless recording, one of those that you want always to turn a little higher—the music sounds too distant. It'll take it here, and you'll find Szell's playing superb; the louder the better.

Mozart, Concertone in C Major, K. 190; Symphony #23, K. 181.
Members of Vienna Symphony, Swoboda.
Westminster LP: WL 50-13

Mozart, Serenade #5, K. 204; Symphony #22, K. 162.
Members of Vienna Symphony, Swoboda.
Westminster LP: WL 50-5

Karl Stamitz, Sinfonia Concertante in F for seven solo instruments.
Vienna Symphony, Swoboda.
Westminster LP: WL 50-17

These are but samples of the increasing line of extremely interesting Mozart and Mozart-period items being dug up and tape-recorded in Vienna by Westminster. None of these has been recorded before, to my knowledge—few have ever been heard at all in this country. Yet every one is of a great deal more than passing interest, and some of the items are absolutely first rate; moreover the performance averages far above the run of current hastily-put-together LP's of similar music, and technically I'd say this company has set a standard of excellence that is actually above that of the major companies in the field! That is, sight unseen, I'd trust a Westminster LP, at this point, to be satisfactorily wide range, distortion-free, with good balance and acoustics much more quickly than I'd trust any major-company LP except perhaps London's recent output. All goes to show what astonishing things LP has meant already.

No room for details as to the above music, except that the Serenades, etc. are "in-between" music, not "chamber" in our sense, not quite orchestra; more a small orchestra of solo instruments. As any recording engineer knows, these in-between combinations are the ideal material for recording—whether 18th century or 20th—and a comparison with the early Mozart symphonies here, for somewhat less solo-like groups, will show the difference in clarity immediately. Karl Stamitz was one of the pioneer Mannheim composers who developed the style which Mozart used, now usually called by us the "Mozart" style. Listen and you'll see where Mozart got his musical language. (The Stamitz, incidentally, is the first Westminster I've hit that is under par in the cutting—it distorts in my copy.)

You'll find an equivalent series of interesting minor Romantic works in the Westminster series, also well recorded—Suk, Goldmark, Rimsky-Korsakov, R. Strauss, and so forth.

TECHNICANA

[from page 6]

made use of a simple photographic technic. A small lamp is moved up and down as it traverses one plane in the sound field. The intensity of the light is varied in accordance with the amplified voltage from a sound level meter fed by a microphone adjacent to the light bulb. The photography is done in a darkened room. With the camera focused on the plane to be traversed the picture of the radiation is formed by a series of scanning lines in the same manner as a television picture. The photographs were taken with a Polaroid-Land camera to facilitate readjustment of the apparatus until high quality pictures were obtainable.

Reflexed Radio Receiver

A new and easily constructed version of the familiar reflex circuit radio receiver is discussed in the Brazilian journal *Revista Radiotecnica*. This circuit,

Fig. 1, uses one tube for the dual purpose of r.f. and a.f. amplifier and rectifier. In previous reflex circuits only the former dual function was performed, but with the use of the dual section 117L7 which contains a beam power amplifier and a half-wave rectifier it is easy to obtain all three functions. The construction is simple and the quality claimed is adequate. However no distortion figures are available and no values of required input signal strength were given. Nonetheless the circuit provides a simple receiver for shop or monitor use.

Magnetic Recording

"Adjustment for Obtaining Optimum Performance in Magnetic Recording" is the title of an article by Albert W. Friend appearing in the March 1950 *RCA Review.* It reviews briefly the fundamentals of tape recording as an introduction to the problems of noise and second harmonic distortion. These are attributed to magnetization of the recording head or direct current in the recording coil. The effect of switching transients of large magnitude is to produce a direct current bias through magnetization also. Any of these resultant d.c. biases raises the noise level, in the same manner that the signal produces modulation noise, and increases the second harmonic distortion. It is also stated that pre-polarization of the recording medium produces the same effect as a d.c. bias on the recording head. Using extremely precisely made heads, RCA P-4, the results of cancellation of the d.c. bias by the application of an external d.c. signal were studied and the reduction of both noise and second harmonic was considerable, as was predicted. The adjustment of the system for either minimum second harmonic or minimum noise requires the same value of d.c. correcting bias, and simultaneously reduces higher harmonics.

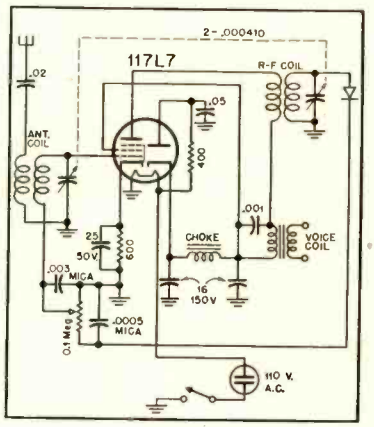


Figure 1

The remainder of the article shows the

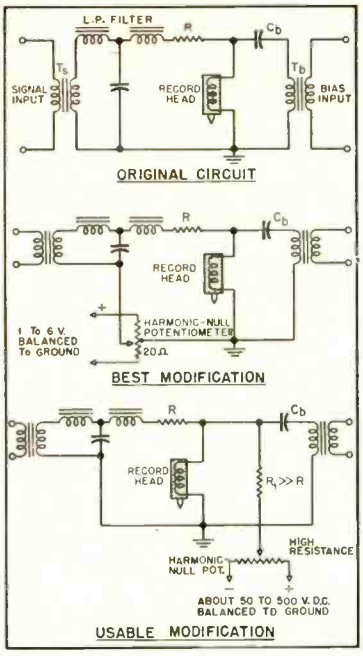


Figure 2

test results of a tape recording system using the P-4 heads and MMM 111 recording tape under varying conditions of signal and bias. *Figure 2* shows the original recording circuit and two equally satisfactory modifications for obtaining the d.c. bias to reduce noise and harmonic content.

Telephone Repeaters

A thorough review of voice frequency repeaters is carried in the *Automatic Electric Technical Journal*, April 1950. In an article by H. C. Talcott the design of the Automatic Electric Type 47 VF Repeater is detailed. The need for toll telephone line repeaters is shown by the example using 1000 miles of 16-gage loaded cable, which has a loss of 190 db. Instead of trying to compensate for this loss at any one point repeaters are spaced about every forty miles. One im-

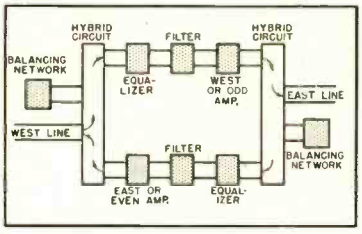


Figure 3

portant consideration in voice frequency repeaters is that the input and output amplifiers feed only one pair of wires each. Therefore wihout any intermediate device it would be impossible to obtain anything but feedback singing from a

pair of amplifiers amplifying the signals going in opposite directions. However, there is a device which will feed the signal from line to amplifier in one direction and from amplifier to the same line in the opposite direction and which prevents feedback singing. This is the hybrid coil, *Fig.* 3.

The requirements of a two-wire repeater in general are:

1. The use of one-way amplifiers designed to provide the necessary gain required to overcome line losses.
2. The use of special hybrid circuits for converting two-wire circuits into four-wire circuits.
3. The use of proper balancing networks for closely approximating the impedance of the line and associated apparatus.
4. The use of filters for eliminating any energy outside the frequency range necessary for good quality voice transmission.
5. The use of miscellaneous apparatus and circuits for adapting the telephone repeater to standard operating practices. Power, testing, signalling, equalization, regulation, and maintenance considerations are included here.

Among the important features of repeaters are bypass circuits that permit d.c. and the 20-cps, 135-cps, and 1000-cps signalling voltages as well as the 3.5-cps dial pulses to be transmitted. The block diagram, *Fig.* 4, shows the features of the Type 47 VF repeater as described in the article.

The *International Projectionist* for June 1950 carries an important note on the development of an Electrical Analog for the Mechanism of Hearing by staff members of Bell Telephone Laboratories. The analog corresponds to the physiological structure (described by Goodfriend in Æ p. 22, May, 1949 and consists of a 175 section transmission line of lumped parameters. Each series resonant shunt section corresponds to a section of the basilar membrane. The range of resonant frequencies is from 17,000 to 500 cps. The voltages along the line, which are available at jacks, correspond to the motion along the basilar membrane. Measurements made on the line show reasonably good agreement with observations on the cochlea.

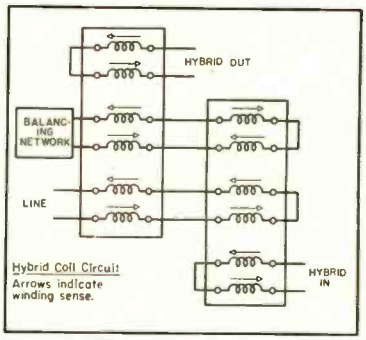


Figure 4

Flying Mammal Sonar

Bats' use of ultrasonic "echolocation," a form of sonar, is carefully documented in a paper appearing in *The Journal of the Acoustical Society of America,* March 1950. "Measurements of the Ultrasonic Cries of Bats" by Donald R. Griffin details the history of the study of bat cries and obstacle avoidance and then continues with a series of oscilloscope photographs showing the nature of the ultrasonic sounds emitted by bats. These sounds have a frequency range from 31 to 120 kc for the little brown bat, and vary in intensity from 95 to 118 db (referred to 0.0002 dynes/cm²) within 10 cm of the bat. The energy is concentrated in a forward direction and has a duration of less than 2 milliseconds. The pulses appear to be frequency modulated starting at a high frequency and going down about one octave during the pulse. The rate at which the pulses of ultrasonic energy is emitted vary from 20 to 60 per second. A brief description of the audible cries of the bats indicates that the energy lies in the region from 7 to 15 kc but usually near the lower end of this region, but is not used for guidance.

AUDIANA

[from page 36]

or open box the dimensions across the face may often have to exceed six feet.

The mathematics of the reflexed box limit its study at this time because of lack of space. However, with it the range of a speaker may be extended and accentuated in the low-frequency region. The analogous electrical circuit is given at E in *Fig.* 3.

The use of dynamical analogies in the study of electro-acoustical systems facilitates rapid analysis of the problem, and from the discussion presented it may be seen that the use of the analogies is limited only by the ability of the engineer to adapt his thinking. It is granted that to initiate a change in methods is always difficult, but anyone now using other methods who adopts analogies as a tool for analysis will later be rewarded by the reduction of effort and time in handling complex systems.

REFERENCES

Harry F. Olson: "Dynamical Analogies," New York: D. Van Nostrand Co. Inc., 1943, and "Elements of Acoustical Engineering," 1947.

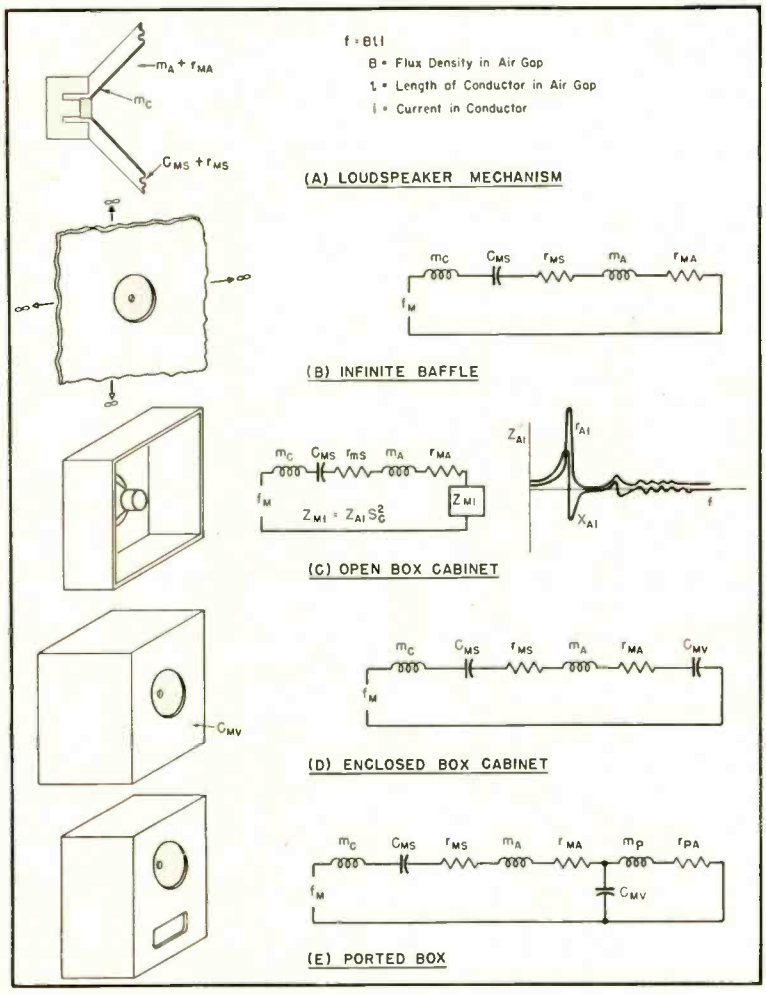


Figure 3

OPERADIO ACQUIRES SOUND SLIDE-FILM PATENT RIGHTS

Operadio Mfg. Co., St. Charles, Ill., has recently acquired from Bendix Aviation Corporation exclusive rights together with sublicensing rights under the group of Jenkins and Adair patents. These patents relate to present-day automatic sound slide systems controlled by signals on either record or tape.

NEW LOUDSPEAKER

[from page 23]

somewhat below the 600-cps crossover frequency. The mouth area is several times that of some designs aimed at a low crossover frequency. Due to the limited operating range prescribed, the large horn mouth size is still consistent with good polar behavior up to 4000 cps.

Many intricate problems were posed by the projected design of a tweeter to operate at frequencies approaching 20,000 cps. The smaller excursions required by the relatively high frequency band covered by this unit make it possible to utilize a light moving system and small clearances. In the G-610 the tweeter diaphragm assembly utilizes a light but stiff phenolic diaphragm driven by a one-inch aluminum voice coil, with moving system dynamic mass of 130 milligrams. Here again, a high-energy magnet structure is used, furnishing an airgap flux density of 15,500 gauss. Sound chamber clearance, while relatively small, greatly exceeds the peak diaphragm excursion occurring when the loudspeaker is operated at maximum rating. This small clearance required special design considerations. Commercial tolerances for mouldings and die-castings did not offer the extreme accuracy of contour and clearances required, necessitating precision machining for final contouring. As a consequence of these design features, excellent performance of the tweeter is assured to at least 18,000 cps, at which point sound pressure response is down only 3 db from the 60–400 cps average level of the system.

For smooth performance, the mouth size of the Hypex high-frequency horn was chosen as 1½ inches so that its size is somewhat greater than one-third of a wavelength at the lowest frequency in the passband of the unit. This small mouth size, combined with the appropriate Hypex-formula flare, produce excellent spatial distribution. The over-all response does not vary appreciably over extremely wide listening angles. The circular mouth configuration achieves an identical spatial distribution in both horizontal and vertical planes. Optimum placement and streamlining of the unique tweeter assembly minimize obstacle effect and maintain a smooth response over the entire operating range of the loudspeaker.

All electrical crossover and response control elements are contained in a separate chassis with connecting cable to plug into the loudspeaker. Conventional *LC* crossover networks employ high-Q air-core inductors to avoid introduction of distortion inherent in iron

cores. While iron cores have a permeability subject to variation with power level and frequency, the permeability of air is constant, thereby allowing no nonlinear distortion effects. Through use of generous sized components, total insertion loss of the network has been held to a maximum of 0.3 db. Incorporated internally in the network is a three-step level adjustment for controlling the middle- and high-frequency response of the G-610. This optional adjustment was found desirable following many subjective tests in various rooms to allow for compensation of room size and absorption characteristics affecting these regions. Coupled to the network are two external controls. An L-pad over-all volume adjustment supplies individual loudspeaker control in multiple installations. A four-position high-frequency cutoff control permits graduated restriction of the high-frequency response to a lower limit of 4000 cps to match the requirements of the source material.

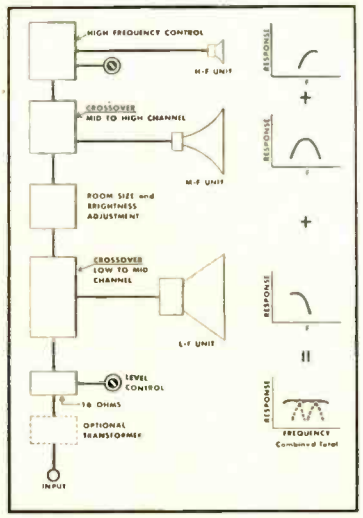


Fig. 3. Schematic of three-way crossover and control system, Model G-610 Triaxial.

Distortions and noise which may be present in associated equipment and source material can be minimized as required. While input impedance is 16 ohms, provision is made on the network chassis for plug-in connection of transformers to match amplifier impedances of other values. Electrical arrangement is shown in *Fig.* 3.

Subjective Realism

Objective measurements have clearly shown that the G-610 combines the widest range, lowest distortion, and best efficiency of any loudspeaker system available commercially. This unit takes its place as one of the strongest links in the audio reproduction chain, as adjudged by its smooth, balanced response,

uniform polar pattern, and clean-cut transient response. But what of the subjective performance of such a system?

Extensive listening tests by engineers, musicians and untrained listeners selected at random have been relied upon to evaluate this most important aspect, and to point the way to useful conclusions. Source materials selected were representative of all types of program material, ranging from live studio orchestral and choral groups and sound effects to AM broadcasts and shellac records. Microphones used on recording and on live direct pickups were new high-quality dynamic and condenser types. Amplifying equipment included the new extreme range, low-distortion types as well as more conventional "20–20,000" types. Comparisons were made on blindfold test basis with all the most generally accepted commercial loudspeakers intended for wide-range response.

The unmistakable conclusion coming from a long series of listening tests is that the G-610 makes available a type of reproduction which creates a new, vastly higher standard of meaning for the term "high fidelity."

Listeners are fascinated by the overtone detail of instruments adding to the illusion of listener presence at the original performance, and by the striking naturalness of background sounds. The untrained listener, who up to this time had shied away from "high fidelity" as having somewhat screechy, thin, raucous tendencies, is particularly impressed by hearing music which so closely simulates the original.

Much of the definition and detail identifying and characterizing voice and musical instruments are contained in the extreme frequencies. These are reproduced by the G-610 at considerably higher levels than is the case with ordinary loudspeakers. An outstanding characteristic of this unit is its increased "resolving power," which makes each orchestral instrument stand out in its own right. The hard, initial hammer-attack transients of the piano, and the delicate timbre and shadings of the voice are conveyed with unsurpassed clarity. The swishes, rattles, and shimmering sounds of the "noisemaker" instruments —gourd and triangle—are present in lifelike individuality.

Listening at high volume levels is a new experience with the G-610, for it can be "opened up" without accompanying listener fatigue or discomfort. A commentary on the high conversion efficiency of this unit is the small power required to cover large auditoriums with sound. As an example, in a preview demonstration of the G-610 before 200 persons in a well-treated room of 82,000

cubic feet, the maximum average input powers used were on the order of 3 to 4 watts.

From its tremendous, clean dynamic range to its smooth, realistic duplication of the source, the Triaxial has achieved what we like to call "transport to the original."

AUDIO PATENTS

[from page 12]

its output feeds another voltage divider. The audio signal appearing at the rectifier input may resemble (A) in *Fig. 3*, which is what the low-level triodes receive. The output of the full-wave rectifier, however, contains both negative and positive peaks, all on the same (negative) side of the baseline, as at

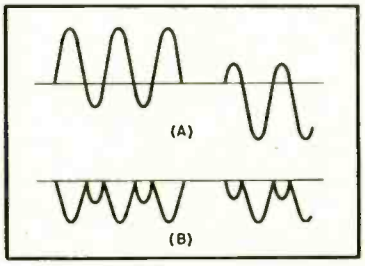


Figure 3

(B). The signal fed to the triodes handling the signals of – 4db and above will show how exactly what is happening, and the operator can see a peak of either polarity when it comes along.

The diagram shows only six neon-control triodes for the sake of simplicity. Seven more must, of course, be included in a practical system to drive the additional lamps shown.

At one time very fast db meters were tried out by a number of organizations, but operators objected to the eyestrain involved in following a fast-flickering needle. In addition, there was only very poor indication of average level, which is important, too. A practical adaptation of the system in this patent might include the neon arrangement, with a standard VU meter as well. Properly arranged lights would not be likely to bother the eyes in the same way as a flickering needle and the modern VU meter is especially designed ballistically to show average level.

A copy of any patent may be obtained for 25¢ from the Commissioner of Patents, Washington 25, D. C.

BOONTON RADIO CORP. ELECTS OFFICERS

Boonton Radio Corporation announces the following changes in management, effective Sept. 1, 1950: W. D. Loughlin has been elected Chairman of the Board of Directors; Dr. G. A. Downsbrough, President; and Dr. D. M. Hill, Vice-President in Charge of Research and Development.

NEW LITERATURE

● **Audak Company,** 500 Fifth Ave., New York 18, N. Y. has recently published a new illustrated catalog containing full description and prices of the entire line of Audak audio components, including reproducers, tone arms, cutters, and equalizers. Copy may be obtained by writing direct to the manufacturer.

● **Cornell-Dubilier Electric Corporation,** South Plainfield, N. J. announces publication of Catalog No. 410 on its Powercon line of vibrator converters. In addition to equipment listings, the 32-page booklet contains a vibrator selection guide, in the form of a table for quick reference.

● **Insulation Manufacturers Corporation.** 565 W. Washington Blvd., Chicago 6, Ill. announces that Insulation Items, an 8-page publication issued every month, will be continued indefinitely. Copy of the free booklet, which covers a variety of electrical insulation subjects, may be obtained by writing to the address shown above.

● **Measurements Corporation,** Boonton, N. J. has just issued the second in the series of Measurements Notes. Subject of the paper is "Measurement of Receiver Impulse Noise Susceptibility."

● **Standard Transformer Corporation,** 3580 Elston Ave., Chicago 18, Ill. announces publication of a new edition of the Stancor catalog of transformers and related components for radio, sound and industrial applications. The 20-page illustrated booklet may be obtained direct from Stancor or from any of its distributors.

● **United Transformer Company,** 150 Varick St., New York 13, N. Y. is now distributing Catalog 500, a 28-page illustrated booklet listing the full UTC line of transformers, reactors and filters. Also included is a variety of amplifier circuits, curves and useful charts. Copy will be supplied without charge upon request.

● **Superior Electric Company,** Bristol, Conn. is now distributing Bulletin 749, a 12-page booklet describing the 1950 line of Powerstat light dimming equipment. Along with descriptions of the equipment, several pages are devoted to suggested uses ranging from TV studios to church applications. Copy may be obtained free by writing.

● **Magnetic Recording Tape.** A new tape designed to meet the requirements of every type of user and produced by specialists in plastics and precision coating with more than a quarter century of experience has just been introduced. The new tape, Hifitone, is made to exacting sound and durability standards with smooth red oxide coatings of high coercive force, and is available with either paper or plastic base, reeled with coated side in or out as required. 150, 600, and 1200-foot spools are supplied normally on plastic reels, or on metal reels when specified. Further technical data may be obtained from Duplitex Laboratories, 1770 W. Berteau Ave., Chicago 13, Ill.

● **Rek-O-Kut Company, Inc.,** 38-01 Queens Blvd., Long Island City 1, N. Y., offers without charge its new catalog of hi-fidelity recording and transcription equipment. The catalog is liberally illustrated and contains complete price information.

NEW PRODUCTS

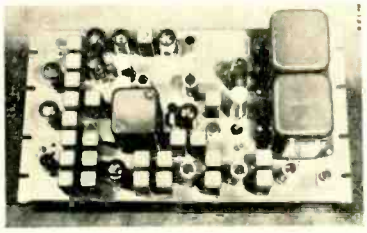
● **Portable Phonograph.** Remarkable fidelity of reproduction is claimed for "The Recitalist," a new three-speed portable phonograph recently introduced by the Rex-O-Kut Company, Inc., 38-13 Queens Blvd., Long Island City, N. Y.

Well suited for use in schools, studios, advertising agencies and small auditoriums, the Recitalist contains a microphone input and permits mixing of live voice or music with recordings. Turntable is made of machined aluminum. Sixteen-inch tone arm contains dual-stylus cartridge. Dimensions of the unit when closed for carrying are 17 × 9½ × 21¼ in. and weight is 38 pounds. Descriptive material is available from the manufacturer.

● **FM–TV Sweep Generator.** Although portable and designed essentially for servicing FM and TV receivers, Sylvania's new Type 500 generator offers a range of performance and control normally expected only of laboratory instruments. Four output bands are provided, permitting fundamental output frequencies ranging from 2 to 230 megacycles. Sweep range for FM is 0 to 600 kc, and for TV

is 0 to 15 mc. Adequate drive for all servicing operations is assured by 100-millivolt output on all bands, with attenuator providing continuous control. Double shielding prevents signal leakage and built-in regulated power supply assures frequency stability. Internal voltage is supplied for driving or synchronizing horizontal scope deflection, and wide-range phasing control permits adjustment for single scope-response curve. Type 500 is designed to operate from standard line voltage, consumes 30 watts, and measures 11½″ × 8¾″ × 7″. Full technical data may be obtained from Radio Tube Division, Sylvania Electric Products, Inc., 500 Fifth Avenue, New York 18, N. Y.

● **FM Relay Receiver.** The REL Model 722 receiver is a rack-mounted single-frequency crystal-controlled double i.f. superheterodyne designed essentially for regional FM networks, but equally adaptable to any application calling for exceptionally fine performance. Distortion is less than 0.5 per cent over a frequency range of 50 to 15,000 cps, sensitivity noise factor is better than 6 db, and sputter point is less than 2 microvolts. Normally supplied for the 88-to-108 mc band, Model 722 may be modified for operation on any frequency from 40 to 216 mc. Technical



data may be obtained from Radio Engineering Laboratories, Inc., 35-54 36th St., Long Island City, N. Y.

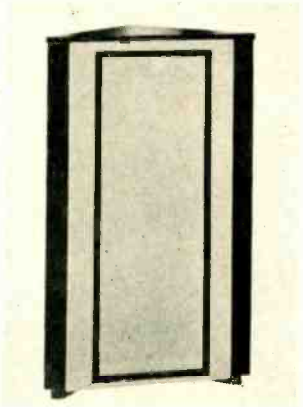
● **Improved VoltOhmyst.** RCA's announcement of the Senior VoltOhmyst brings to the service field an electronic voltmeter capable of direct peak-to-peak measurement of complex waveforms up to 1400 volts. Designed especially for television signal tracing, the new unit permits the measurement of sync pulses, composite wave shapes, and deflection voltages in television receivers without time-consuming computations. Peak-to-peak values are read directly from scale. Designated Type WV-97A, the Senior VoltOhmyst provides seven d.c. ranges, seven a.c. ranges, seven peak-to-peak ranges, and seven resistance ranges. Resistance

values from 0.1 ohm to 1000 megohms may be read with only 1.5 volts applied to the circuit under test.

A lightweight and versatile instrument,

the WV-97A is provided with three cables, a d.c. probe, and a slip-on alligator clip. Available accessories include a slip-on crystal probe for u-h-f measurements, a high voltage probe, and a multiplier re-resistor.

● **Corner Speaker.** Latest entrant into the field of speakers designed for corner installation is the Model 802-C two-way speaker system now available from Holl

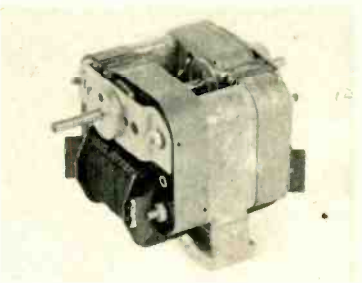


Audio Industries, Hollywood 28, Calif. The 802-C makes use of a 15-in. woofer with 2-in. voice coil, and cross-over frequency is 800 cps. The area of the cone, the air column, and the port are approximately equal so that maximum loading is obtained. Size of the cabinet is 50 in. high × 28 in. wide × 16 in. deep. Power rating is 20 watts. Effective design and corner-type construction make possible an efficient bass horn calling for a minimum of floor space.

● **P.A. Amplifiers.** New and distinctive styling is featured in the "Green Gem" line of amplifiers recently introduced by Rauland-Borg Corporation, 3523 Addison

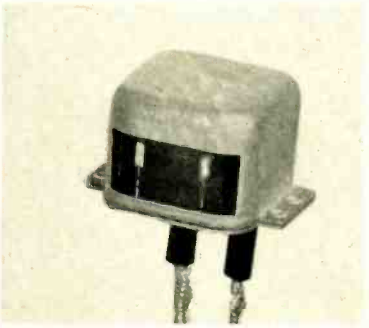
St., Chicago 18, Ill. First of the new line to be released is Model 1916 with 16-watt rated output at five per cent or less harmonic distortion. Two high-impedance microphone inputs and one phono input are provided, with mixing controls on all three. Frequency response is 40 to 20,000 cps ±1 db. Complete technical specifications covering the entire Green Gem line may be obtained from the manufacturer.

● **Reversible Motor.** Manufacturers of equipment making use of small, reversible motors will find interest in the new DYAB tandem motor recently put into production by Barber-Colman Company, Rockford, Ill. Specifications include maximum output of 0.004 or 0.006 hp, shaded-pole design, stainless steel shaft, and molded



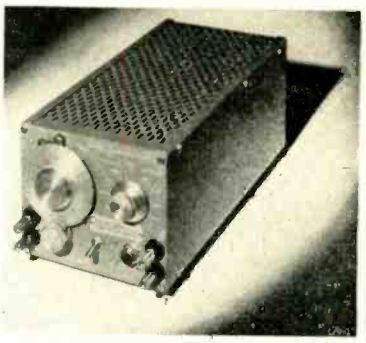
plastic moisture-proof spool. According to the manufacturer the new unit is especially well suited for wire recorders, measuring instruments, remote-tuning transmitters and similar applications.

● **Tape Recording Head.** Claimed by the manufacturer to be the only tape recording head in the industry engineered for mass production, the new TR5 head now being produced by Shure Brothers Inc., 225 W. Huron St., Chicago, Ill. combines the functions of record, erase and playback in a single unit. Unique design assures production control of gap dimension and alignment. Hum is minimized through use of a mu-metal shield. Ease of as-



sembly in equipment and excellent performance characteristics combine to make the TR5 head of unusual interest to manufacturers.

● **Variable Electronic Filter.** Although designed essentially for application in the movie, radio, television, and recording fields, the new Model 300 electronic filter recently announced by Spencer-Kennedy is an ideal research instrument for noise analysis or acoustic measurement in laboratory and industry. Frequency range of the filter is 20 cps to 200 kc with continuously variable cutoff and an attenuation rate of 18 db per octave. A range



switch selects the type of section desired —high-pass or low-pass—as well as four decade frequency ranges. Full information may be obtained by writing Spencer-Kennedy Laboratories, Inc., 186 Massachusetts Ave., Cambridge 39, Mass.

● **Crystal Microphone.** Remarkable front-to-back ratio is stressed by the manufacturer in announcing the new

Synabar Model DR-10 microphone. Unidirectional cardioid type, the DR-10 makes use of a special sintered metal to virtually cancel out rear pickup. Frequency response is 50 to 10,000 cps, with a switch provided to vary characteristics for voice or music pickup. High impedance output level is −54 db. Manufacturer is Astatic Corporation, Conneaut, Ohio.

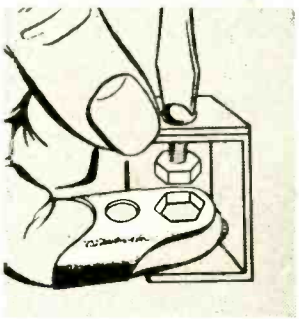
● **Plastic Tape.** Formerly sold only to the professional trades, Dutch Brand Plastix tape is now available through retailers in convenient 150-ft. rolls. Because

it is exceedingly thin, has 200 per cent stretch and high dielectric resistance, Plastix tape is well suited for splices where space is limited. Further information may be obtained from Van Cleef Bros. Inc., 7800 Woodlawn Ave., Chicago 19, Ill.

● **DC-AC Chopper.** Longer life and lower noise level, together with decrease in size and weight, are all featured in the new Type 268 DC-AC chopper recently placed in production by Stevens-Arnold. Frequency range of the new model is 10 to 500 cps for all commercial purposes; tests now in progress indicate that operation as high as 800 cps may be commercially feasible. Average ratings are 10 volts at 1 ma d.c., although both these values may be exceeded on an intermittent basis. The entire unit is hermetically sealed and fits a standard 8-pin octal

base. Technical description will be supplied free by the manufacturer, Stevens-Arnold, Inc., 22 Elkins street, South Boston 27, Mass.

● **Finger Wrench.** "Touch 'N' Grip" is the name appropriately applied to a small wrench for placing, holding and tightening nuts in out-of-the-way or out-of-sight locations in electronic or electrical equipment. Also, the wrench minimizes the need for picking up and putting down tools, since it is worn like a thimble and does not limit the use of the hands. Manufacturer is F. E. Redfield Company, 31 Colonial Parkway, Dumont, N. J.



● **Control Track Generator.** A boon to the TV and sound-on-film fields is this new device which makes possible the use of many standard magnetic-tape recorders for picture-synchronous sound-track recording, and which is available for immediate delivery from Fairchild Recording Equipment Corporation, White-

CLASSIFIED

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

Equipment

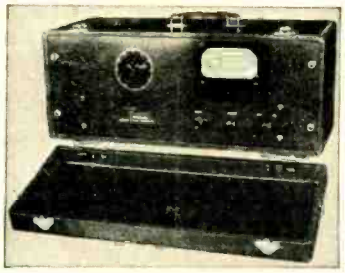
FOR SALE: Presto 90-A Amplifier, three mike inputs, 30-15,000 cps, $250; Brush three-hour wire recorder with extras, $195 (orig. cost $800); sell both as unit $395. 2 Presto 1-D heads, $60 each. 2 transcription arms, $8 each. Presto AM tuner and FM Pilotuner $50. Reco-Art Sound Recording Co., 1305 Market St., Philadelphia 7, Pa.

FOR SALE: University dual tweeters, $16; network $4. Bogen 10-watt amplifier, $19. GE S1201-D speaker, $12. Bozak dual tweeters, $12. Livingston Universal arm, $10. GE 810 speaker $3. R. D. Balzer, 435 E. 74th St., New York 21, N. Y.

FOR SALE: Presto 6N, 1-C cutter, 87A amplifier, Rek-O-Kut G-2 turntable, Turner U9S, Shure 55C, stands, cables, cases, $450. Box CP-1, AUDIO ENGINEERING.

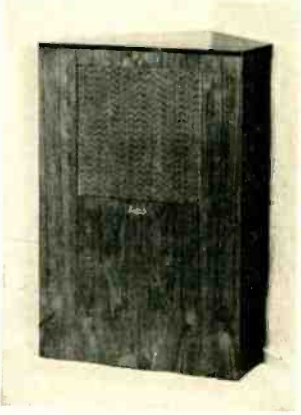
Records

FOR SALE: Victor albums M-935, Swarthout, $2.50; DM-740 Brahms-Horowitz, $4.50; M-358, Gershwin, $1.50; DM-1224, Handel, $2; AM-509, Rimsky-Korsakov, $4.50; Decca ffrr EDA-16, Dukas, $2.25. All in fine condition, used only with diamond stylus. F.O.B. New York, Box CS-4, AUDIO ENGINEERING.



stone, N. Y. In operation the control track generator superimposes a high-frequency signal on the magnetic tape simultaneously with the sound track. This signal becomes the tape speed control during playback. When played back on a Fairchild Pic-Sync recorder the control track compensates for tape stretch and shrinkage, maintaining lip-sync between the sound track on the tape and the picture on the film. No extra heads or modifications to presently owned tape recorders are required. Full technical specifications are available from the manufacturer.

● **Corner Speaker.** Corner horn loading is combined with direct radiation in a new speaker system designed by Klipsch and Associates, Hope, Arkansas. Desig-



nated the Rebel, the new unit is said to offer exceptionally smooth response and low intermodulation. Although designed by the makers of the famous Klipschorn, it is substantially lower in price. Available in a variety of finishes including walnut, oak, mahogany, and enamel on unfigured hardwood. Full details will be supplied without charge by the manufacturer.

● **Sweep and Marker Generator.** Overall alignment of TV receivers as well as alignment of front ends is facilitated by the Marka-Sweep, recently introduced to the trade by Kay Electric Company, Maple Ave., Pine Brook, N. J. Available

in two models differing only in the type of marker employed, the Marka-Sweep employs a 12-position channel switch which selects extremely narrow crystal-positioned picture and sound carrier markers as well as the usual 15-mc sweep oscillator output. All carriers are oscillator fundamentals. The Marka-Sweep is entirely electronic in operation. Use of a regulated power supply together with the all-electronic sweep generator assures a high degree of operating stability.

● **Isolation Transformer.** Of equal interest to service men and testing laboratories is the new 350-watt isolation trans-

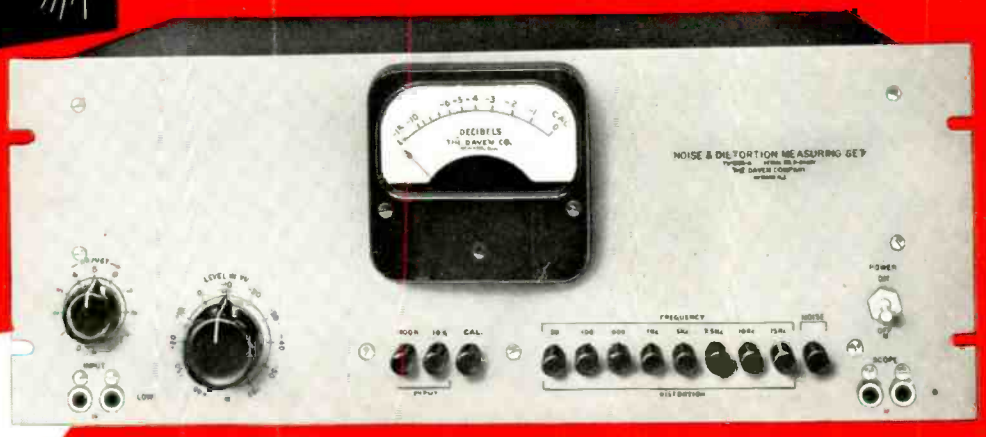
former now being manufactured by Standard Transformer Corporation, 3580 Elston Ave., Chicago, Ill. In addition to providing isolation, the unit may be used to correct for either high or low line voltage, three standard receptacles affording 105, 115, and 125 v.a.c. output from 117-volt input.

● **Communications Recorder.** Departing in many respects from the conventional magnetic recorder, the Audiolog makes use of a thin, flexible, reusable sleeve of magnetic material upon which a full hour of speech or code can be recorded. In operation, the magnetic recording sleeve is slipped over an internally-driven rotating drum. Separate recording and play-back heads move laterally across the drum, so arranged that any recorded portion can be played back while recording is in progress. Both heads are equipped with inexpensive pole pieces which can be quickly replaced when worn. The recording head contains an advance magnet which automatically erases previously recorded material when sleeves are being re-used. The flexible sleeves can be telescoped so that a 24-hour log can be filed as a compact unit. Complete information may be obtained from Audiolog Corporation, 440 Peralta Ave., San Leandro, Calif.

Coming to
THE AUDIO FAIR ?
Oct. 26, 27, 28

ADVERTISING INDEX

...Automatic Push-Button Tuning



An Exclusive Feature of the New

DAVEN

Distortion and Noise Meter Type 35-A

The DAVEN Type 35-A, Distortion and Noise Meter, is a new, skillfully engineered instrument that provides a rapid, accurate means of measuring distortion, noise and hum level in audio frequency equipment.

Of particular importance is the fact that there is no balancing or laborious time consuming tuning required to make measurements. The user need only push a button and the unit is automatically balanced.

This is accomplished by the use of a series of 8 fixed band rejection filters covering the range 50 cycles to 15 K.c., followed by a stable, high quality, wide range (50 cycles to 45 K.c.), high gain amplifier. There are no tube circuits or other sources of inherent distortions, making it possible to measure low levels of distortion accurately over a wide level range.

SPECIFICATIONS

RESIDUAL DISTORTION: No tube circuits or non-linear devices between input of set and filter input.

DISTORTION MEASUREMENTS: Filters provided for 50, 100, 400, 1000 cycles, 5 Kc, 7.5 Kc, 10 Kc, and 15 Kc with cut off of −70 db. Distortion measurements to 0.1% full scale meter deflection with zero level input.

NOISE MEASUREMENTS: With zero db input, limit is −80 db. At +40 input, limit is −115 db below input.

AMPLIFIER FREQUENCY RANGE: 50 cycles to 45 Kc.

ACCURACY: Filters are down 70 db at fundamental frequencies, and within ±0.5 db of flat response at the second harmonic. Absolute accuracy of measurement can be depended upon to be within ±5%.

RESIDUAL NOISE LEVEL: Below −80 db at gain control full on. Multiple gain control employed so that residual noise drops to −90 db. when gain control is set at −30, −100 db when gain control is set at −20, etc.

Write for detailed information

THE DAVEN CO.
185 CENTRAL AVENUE
NEWARK 4, N. J.

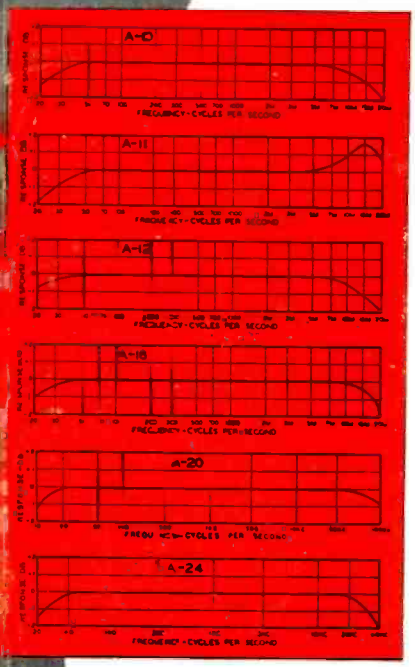
SEE DAVEN AT THE AUDIO FAIR, ROOM 616

ULTRA COMPACT UNITS...OUNCER UNITS

HIGH FIDELITY . . . . SMALL SIZE . . . . FROM STOCK

UTC Ultra compact audio units are small and light in weight, ideally suited to remote amplifier and similar compact equipment. High fidelity is obtainable in all individual units, the frequency response being ± 2 DB from 30 to 20,000 cycles.

True hum balancing coil structure combined with a high conductivity die cast outer case, effects good inductive shielding.



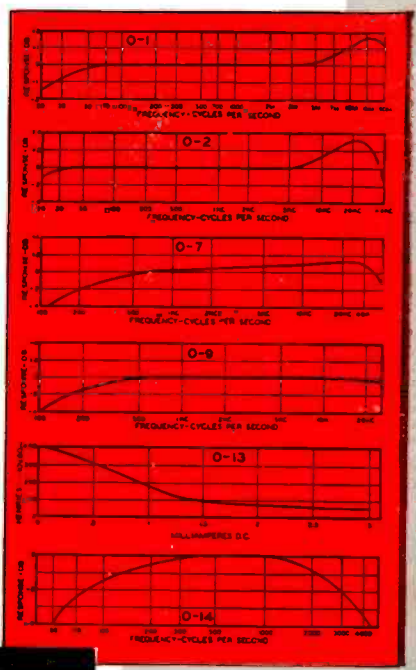
Type No.	Application	Primary Impedance	Secondary Impedance	List Price
A-10	Low impedance mike, pickup, or multiple line to grid	50, 125/150, 200/250, 333, 500/600 ohms	50 ohms	$15.00
A-11	Low impedance mike, pickup, or line to 1 or 2 grids (multiple alloy shields for low hum pickup)	50, 200, 500	50,000 ohms	16.00
A-12	Low impedance mike, pickup, or multiple line to grids	50, 125/150, 200/250, 333, 500/600 ohms	80,000 ohms overall, in two sections	15.00
A-14	Dynamic microphone to one or two grids	30 ohms	50,000 ohms overall, in two sections	14.00
A-20	Mixing, mike, pickup, or multiple line to line	50, 125/150, 200/250, 333, 500/600 ohms	50, 125/150, 200/250, 333, 500/600 ohms	15.00
A-21	mixing, low impedance mike, pickup, or line to line (multiple alloy shields for low hum pickup)	50, 200/250, 500/600	50, 200/250, 500/600	16.00
A-16	Single plate to single grid	15,000 ohms	60,000 ohms. 2:1 ratio	13.00
A-17	Single plate to single grid 8 MA unbalanced D.C.	As above	As above	15.00
A-18	Single plate to two grids. Split primary	15,000 ohms	80,000 ohms overall, 2.3:1 turn ratio	14.00
A-19	Single plate to two grids 8 MA unbalanced D.C.	15,000 ohms	80,000 ohms overall, 2.3:1 turn ratio	18.00
A-24	Single plate to multiple line	15,000 ohms	50, 125/150, 200/250, 333, 500/600 ohms	15.00
A-25	Single plate to multiple line 8 MA unbalanced D.C.	15,000 ohms	50, 125/150, 200/250, 333, 500/600 ohms	14.00
A-26	Push pull low level plates to multiple line	30,000 ohms plate to plate	50, 125/150, 200/250, 333, 500/600 ohms	15.00
A-27	Crystal microphone to multiple line	100,000 ohms	50, 125/150, 200/250, 333, 500/600 ohms	15.00
A-30	Audio choke. 250 henrys @ 5 MA 6000 ohms D.C., 65 henrys @ 10 MA 1500 ohms D.C.			10.00
A-32	Filter choke 60 henrys @ 15 MA 2000 ohms D.C., 15 henrys @ 30 MA 500 ohms D.C.			9.00

TYPE A CASE
1½" x 1½" x 2" high

UTC OUNCER components represent the acme in compact quality transformers. These units, which weigh one ounce, are fully impregnated and sealed in a drawn aluminum housing ⅞" diameter . . . mounting opposite terminal board. High fidelity characteristics are provided, uniform from 40 to 15,000 cycles, except for 0-14, 0-15, and units carrying DC which are intended for voice frequencies from 150 to 4,000 cycles. Maximum level 0 DB.

OUNCER CASE
⅞" Dia. x 1⅛" high

Type No.	Application	Pri. Imp.	Sec. Imp.	List Price
0-1	Mike, pickup or line to 1 grid	50, 200/250 500/600	50,000	$13.25
0-2	Mike, pickup or line to 2 grids	50, 200/250 500/600	50,000	13.25
0-3	Dynamic mike to 1 grid	7.5/30	50,000	12.00
0-4	Single plate to 1 grid	15,000	60,000	10.50
0-5	Plate to grid. D.C. in Pri.	15,000	60,000	10.50
0-6	Single plate to 2 grids	15,000	95,000	12.00
0-7	Plate to 2 grids, D.C. in Pri.	15,000	95,000	12.00
0-8	Single plate to line	15,000	50, 200/250, 500/600	13.25
0-9	Plate to line, D.C. in Pri.	15,000	50, 200/250, 500/600	13.25
0-10	Push pull plates to line	30,000 ohms plate to plate	50, 200/250, 500/600	13.25
0-11	Crystal mike to line	50,000	50, 200/250, 500/600	13.25
0-12	Mixing and matching	50, 200/250	50, 200/250, 500/600	12.00
0-13	Reactor, 300 Hys.—no D.C.; 50 Hys.—3 MA. D.C.,		6000 ohms	9.50
0-14	50:1 mike or line to grid	200	½ megohm	13.25
0-15	10:1 single plate to grid	15,000	1 megohm	13.25



United Transformer Co.
150 VARICK STREET • NEW YORK 13, N. Y.
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"